THE

ELECTRICAL REVIEW.

VOL. LVII. DECEMBER 15, 1905. No. 1,464.

ELECTRICAL REVIEW.

Vol. LVII.] CONTENTS: December 15, 1905. [No. 1,464.

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FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street Paris: VEUVE J. BOIVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

1906 Edition

NOW IN PREPARATION.

N.B.—Advertisements and Corrections should be sent in at once.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

BRIGHTON RAILWAY ELECTRIFICATION.

AN important announcement was made on Monday last, with reference to the placing of the contracts for the electrical equipment of the first portion of the suburban railways of the L.B. & S.C. Railway. It appears that the directors have finally decided to proceed with the electrification, and that the Allgemeine Elektricitäts Gesellschaft is to be entrusted with the work; negotiations are in progress with the A.E.G. regarding minor details, one of the directors of the company being in London for that purpose.

The system to be adopted is, as previously stated in our pages, the single-phase alternating system with overhead conductors at high pressure. The A.E.G. was the pioneer firm in carrying out an important European installation on this system—that of the Spindlersfeld Railway, which has given entirely successful results during its two years' working—and has received the contract for the electrification of part of the Prussian State Railways in the neighbourhood of Hamburg on the same system. We understand that the company, on the basis of the experience which it has already acquired, has been able to give guarantees for the satisfactory performance of its motors and other apparatus, which in every respect—efficiency, economy, power factor, &c.—are far in advance of any of the proposals put forward by the other firms tendering; further, the price at which the work is to be executed is very substantially less than any of the competing tenders. These considerations, joined to the fact that the A.E.G. was the only firm tendering which had had prolonged experience of heavy single-phase traction under commercial conditions, left no alternative to the directors of the railway but to place the work in its hands.

It must not be supposed, however, that the decision represents a total loss to this country of the large amount of employment resulting from the electrification of the railway. It is, we believe, the patriotic and enlightened practice of the L.B. and S.C. Railway to stipulate, in placing its contracts, that the work shall be carried out with British labour and material. In the present instance, while the electrical equipment for the first few trains will be made in Germany, the whole of the remaining work, including the construction of the car-bodies and trucks, the cables, switchgear, the line equipment, additional motors, and all other apparatus and equipment, will be done in this country. Knowing the relations which exist between the A.E.G. and the B.T.-H. Co., we may safely surmise that a large portion of the work will be carried out at Rugby. The contract, it is stated, will involve an outlay of about a quarter of a million sterling.

The directors are to be congratulated upon the wise and enterprising spirit in which they have dealt with the difficult problem of improving their service and regaining the suburban traffic from the competing tramways. They have shown a lead to their hesitating *confrères* on the directorates of other railway companies, who, no doubt, will watch the progress of the work with keenest interest. Not content with travelling in the old ruts, favoured by those who love fixed standards "not wisely but too well," and their imitators, the directors have moved with the times. All honour to their courage, which, we hope and believe, will be crowned with its due reward.

Overhead versus Underground Lines.

We have before us a paper with the above heading read before the Illinois State Electric Association by Mr. H. B. Gear, of which there is a reprint in the *Western Electrician* for October 14th. Mr. Gear is general inspector of the Chicago Edison Co., and we would expect, therefore, to find a discussion of this question on the most up-to-date lines. In this paper he tries to compromise, and meet the objections of many people, by using overhead high-tension transmission and a partly high tension, partly low tension buried culvert system.

It is somewhat astonishing to find that he recommends for towns of 15,000 to 25,000 inhabitants, an overhead high-tension system, the primary wires being led to transformers placed at the corners of the blocks of buildings he wishes to light. The transformers also are placed not above ground, but in manholes, a method which has been discarded long ago in this country for new work. The low-tension wires are then led from the transformers through ducts to the laterals, where there are smaller manholes communicating with the buildings (at numerous intervals). In another duct of the same culvert run the high-tension wires to the transformer at the next corner of the block of buildings, and then more ducts, &c. Four ducts are put in to allow of future extension, and apparently all these are of the draw-in type. Meanwhile, but two of them are utilised, one high and the other low tension.

Estimating, or "figuring," his secondary copper on a three-wire basis, he arrives at the conclusion that this style of underground work is from four to five times as costly as for overhead of the usual type (with transformers apparently on poles). For average conditions of lighting, he shows that this represents an increase of 6 cents per KW.-hour to the consumers in the blocks of buildings referred to. There would apparently be two scales of charges, one for the "overhead" consumer, and another for the "underground" consumer.

The general idea is to keep the poles out of the way, but to tap the high-tension lines here and there to supply small transformers, the network of culverts being continued from block to block of buildings—the streets running American fashion at right angles.

Mr. Gear apparently does not favour an all underground system, with sub-stations, for the busy parts of the town, with overhead transmission to the outlying portions. Nothing is mentioned, even in the discussion, of the possibility of using a sub-station with motor-generators or rotaries, and a three-wire continuous-current distribution. It seems to us under the circumstances that using many 15 to 25-KW. transformers buried in the ground is somewhat antiquated compared with sub-stations and the usual low-tension network. Further, the costly ducts might be done away with altogether for the distributing cables, and the risks of breakdown enormously diminished.

Climatic conditions may account for much, but it is very curious to notice that there appeared to be complete unanimity on the part of the speaker and his audience that the correct way to supply a town of 15,000 to 25,000 inhabitants was by small transformers of 15 to 25 KW., slung up on poles, or buried in the ground, at the street corners. Nothing was mentioned in the discussion as to the effect of load factor, which simplified matters considerably.

However, Mr. Gear showed very clearly that the initial cost of installing an overhead system is very much cheaper than that of an underground one, and we think that in cases of small towns, up to 10,000 inhabitants, an overhead system with suitable sub-stations and low-tension distribution for the busier portion would in many cases in this country enable light and power to be distributed economically. At present many small places shrink from the heavy initial expenditure of underground construction, and some often afterwards rue the "white elephant" when they have got him.

Mr. Gear also states that depreciation on culverts and on paper-insulated cables is an unknown quantity, but allows *10 per cent.* to cover "changes in the art, changes in the load, and other causes." We quite believe that depreciation on culverts (presumably earthenware) will be difficult to determine, owing to the shortness of human life, since we have read of culverts being discovered in Mexico for water supply originally designed by the Aztec engineers, and, further, wooden pipes (for water) have been discovered in London in a good state of preservation, installed about the time of Henry the Eighth, besides other examples from the never-ending researches at Pompeii, &c.

As regards the paper-insulated cables, however, some facts ought at least to be forthcoming by this time, but at present depreciation seems to be a guess of the wildest type in most cases.

What with countless small transformers, countless manholes, draw-in ducts containing high-tension and low-tension cables, we fear the engineer-in-charge of a system such as Mr. Gear describes, if he did not "go for his revolver," would, at least, use "language we cannot command," in accordance with Bill Nye's Western custom.

The Bow Electricity Works.

Although the American central station engineer is fond of treating his *confrères* to discourses compounded with the valuable igredient of "personal experience," it is rarely that a British engineer condescends to bestow upon his fellows details of the inner experience of his own undertaking.

For this reason, and because an ounce of practice is worth a ton of theory, we gladly welcome Mr. W. H. Patchell's recent paper on the Charing Cross Co.'s City of London works, read before the Institution of Electrical Engineers.

Up to the present an almost Lhasarian secrecy has been maintained as to the later engineering developments of the company, which, however well-intentioned, was not exactly conducive to the popularity of a prominent public concern operating in the heart of the most prominent city in the world.

However, Mr. Patchell's paper solves the mystery, and discloses many matters of more than usual interest, which are incorporated in our illustrated description of the Bow Works and plant elsewhere in the present issue. The fact that the company is operating the largest generators and boilers in this country will certainly surprise the average engineer, who has probably, ere this, relegated the reciprocating engine for electrical purposes to oblivion, in favour of the more fashionable turbine.

Of the large reciprocating plants for electrical driving, the Manchester (Wallsend-Electrical Co.) 3,750-KW. sets, the Metropolitan Co.'s (Sulzer-Kolben) 3,500-KW. sets and the L.C.C. (Musgrave-E.C.C.) generators rank as prominent examples which, however, do not equal in size the 4,000-KW. Sulzer-Lahmeyer units installed at Bow. The latter station can also claim some notoriety for its boiler plant, consisting of Hornsby boilers of unusually large proportions.

Both in design and size the latter possess features which are peculiarly valuable in such circumstances as obtain at Bow.

That Mr. Patchell was the first in the field to operate direct-driven 10,000-volt generators in this country is a matter for personal congratulation, as also is his perspicacity in evading the L.C.C. building restrictions, and thus rendering possible the construction of such an efficient steam generating plant.

Derelict London.

In the decision recently announced to remove Messrs. Yarrow's works from Poplar to the North, a part of the daily Press sees only a local trouble. Most people will rather perceive in it a constitutional disturbance. The rates in Poplar amount to 12s. in the pound, and this is brought forward partially to explain the trouble, and to serve as an excuse for pressing forward the equalisation of rates. But if rates were equalised throughout the Metropolitan area, they would be still far too high everywhere. To begin with, rates are levied in London on assessments which are themselves at least a third higher than on equal property in a city like Manchester. Consequently, a rate of 9s. in London brings in as much as one

of 12s. would bring in Manchester. London's heavy rates are therefore even worse than they appear to be.

A works like Yarrow's is not only pressed upon thus heavily by rates on the works, but has to pay the rates of its workers in the shape of increased wages. It is even questionable whether the higher wages paid in London do meet the workmen's increased cost of living as compared with costs and wages in other towns. So long as Yarrow's practically had no competitors outside the Thames Valley, it did not materially affect their special work. But for foreign work more especially they are exposed to outside competition.

Now, Poplar's needs and Poplar's debts will not, we may presume, diminish because Yarrow's are leaving the place. But Yarrow's will not be there to pay their share, and it will fall on those who remain. The burden is becoming concentrated on shoulders even less able to bear it; on the shoulders of those who cannot get away if they would, but must remain behind in the struggle, and perchance perish in the mêlée. The problem before London ratepayers has now become so severe that no longer is it a question of how to stay the too open hand of expenditure, but of how to reduce expenditure promptly by a considerable amount. That expenditure could be reduced, there can be no manner of doubt. As guardians of the interests of all of us, the London County Council has been weighed in the balance and found wanting.

The Truth about Technical Education.

The great outcry of the engineer, or, rather, of the young engineer at this moment is, as may readily be gathered from our "Correspondence" columns from time to time, that after a youth has learned all sorts of things about chemistry, physics and what not, he can only command the wages of a day labourer. When everyone is technically educated to the point of intelligence, the country as a whole will, no doubt, profit by the transaction, but there will be no better pay for the technically educated than there was when all were possessed only of the three R's. Technical education of the nation's youth is not, from a national point of view, intended to be of direct benefit to the youth. It is rather that British youth shall not lag behind the youth of Germany or any other body of educated youth.

An apology is perhaps due for the use of the word educated. Technical education is in the mouths of all, but what is meant is teaching, and teaching is not education. The average American or German youth is much held up as an example of good technical education, but technical teaching of a youth alone will not make a cultivated gentleman of him, and the too great readiness to measure the value of a technical training entirely in cash is not a hopeful sign. Even good technical training is valueless to the individual as a means by which he can gain a start over equally trained competitors. It is everyone's duty to hold England to her place amongst the nations, but England's place has been gained for her by men who were first honest and next gentlemen, and it seems to us that these simple facts are in danger of being overlooked, and that modern engineers are occasionally less truthful and less clean handed than engineers of old, when there was less of technics about them and more of the humanities. It is easy, moreover, to carry technical training too far into a sham practice, when the time is all too short to acquire principles.

A word as to the shops. There is the utmost difficulty in getting a youth into the workshop. Employers ask for premiums of £300 and so forth on the ground that the boy is a nuisance. Is not the premium plan the very way to make a nuisance—a privileged nuisance—of the boy, who would be less than human did he not feel that he had a right to some fun for his father's £300? Boys ought to be selected in a proper manner, and they should then keep shop hours and conform to shop rules, though they might be passed rapidly through the various departments. We never knew a youth treated on these lines who did not earn his salt, and more than his salt, for his employers. It is an easy matter to pay an apprentice enough for his subsistence and yet to make a profit out of him of 20s. a week.

NOTES ON CONTINENTAL SYSTEMS OF FUSE STANDARDISATION.

By ALFRED SCHWARTZ.

Although we find that a high degree of standardisation exists in the fuse systems in vogue in Germany, this is due to the fact that consumers cannot easily replace a fuse with one of their own fashioning, but must obtain a refill from the manufacturer, who is responsible for its proper rating and marking in accordance with the conditions laid down by the Verband Deutscher Electrotechniker. This system is not a good one in so far as the various large manufacturing concerns have each developed fuse systems of their own, which are not interchangeable the one with the other, and while this doubtless secures the trade in refills to the manufacturer of each particular line, it is hardly conducive to the convenience of the public or the safety of the installations, as in cases of urgency the fuses are sometimes tampered with. If the fuse in this country is often treated with an almost profane familiarity by the consumer, it is by our official-ridden neighbours regarded perhaps in too sacred a light. An amusing contrast between these two views was recently furnished to the writer, who found himself last Christmas at a Swiss Hotel in the high Alps with a number of English people who were bent on amusing themselves one evening with some "tableaux vivants." An arc lamp and a lantern were requisitioned, but the fuse in the arc circuit was found to have been blown. The proprietor, however, promised to send up to the central station, which was situated in a wild ravine at some distance from the hotel, for a refill, and assured us that the engineer would come down and that the new fuse would be in position about an hour and a half after the performance was timed to commence. In due time the engineer arrived, and found to his dire consternation that a distinguished Fellow of the Royal Society, having detached four or five yards of No. 12 galvanised iron wire from a fence outside, had tapped the lighting circuit and connected up the arc lamp through a large electric stove as resistance, and was busily playing the part of "limelights."

The official regulations for the testing of fuses (Vorschriften für die Konstruktion und Prüfung von Installationsmaterial) published in the *E.T.Z.*, 1903, p. 683, are concerned only with fuses of the plug type, with carrying capacities up to 60 amperes. The regulations for these fuses are divided into two parts, the first dealing with the material and construction of the fuses, while the second deals with the necessary tests for approval. Further regulations and general arrangements for the installation of fuses are contained in the safety regulations (Sicherheitsvorschriften) of the German Institution of Electrical Engineers, issued in 1896. These regulations refer to low-pressure work up to 250 volts, with additional regulations for medium pressures from 250 to 1,000 volts, and for high pressures from 1,000 volts upwards. The principal points in connection with fuses contained in these regulations are given in abstract below:—

Vorschriften für die Konstruktion und Prüfung von Installationsmaterial.

Construction and Material.

§ 21. The current-carrying parts of the socket and plug must be mounted on a non-inflammable and non-hygroscopic base, which will not change its form with a temperature of 300° C.

§ 22. The socket must be so constructed that its connection to the conductors is made by means of screws. All screws which are used for making contact must screw into metal.

§ 23. The normal carrying capacity and the maximum pressure for which the fuse is intended must be marked on the fuse holder.

§ 24. As standard current ranges the following are to be taken:—2, 4, 6, 10, 15, 20, 30, 40 and 60 amperes.

§ 25. As standard pressure ranges:—125, 250 and 500 volts.

§ 26. Plug fuses from six amperes upwards must be non-interchangeable, in the sense that they cannot be changed by

careless or irresponsible persons for fuse holders of a higher carrying capacity.

§ 27. Metal parts on the socket or plug which can be touched must be insulated from all live parts.

Experimental Tests.

§ 28. The fuse must successfully withstand for five minutes an alternating pressure of 1,000 volts above the pressure of the circuit for which it is intended. This pressure is to be applied in the first instance with the fuse plug *in situ*, between the screws for holding the fuse block in position and any metal portion of the plug or socket which can, when in position, be touched with the hand. Further, with the fuse plug removed, this pressure is to be applied between the fuse contacts.

§ 29. The fuses are to be tested with continuous current; as a source of current a dynamo or battery or both may be used. From the current supply two conductors are to be taken to the terminals of the fuse, and in this circuit a switch and a regulating resistance which is capable of being short-circuited are to be arranged. The fuse is to be placed as a short circuit to the leads on the far side of the switch and resistance. The voltage across the terminals of the switch must be 10 per cent. higher than the normal voltage of the circuit for which the fuse is intended. Fuses are to be tested both by a sudden short-circuit, and by a slowly increased load.

The following conditions apply to the short-circuit test :—§ 30. The output capacity of the source of current and the resistance of the leads are to be so arranged that at the time the fuse blows the total fall of pressure in them shall not exceed one per cent. These conditions will be regarded as being fulfilled if, in the place of the fuse, an adjustable resistance is placed, arranged to carry a current of 20 times the normal carrying capacity of the fuse (this current must, however, not be less than 400 amperes), and at the same time the pressure across the terminals of this resistance must not be less than the normal pressure of the circuit for which the fuse is intended. When matters have been arranged to comply with the foregoing conditions, the switch is to be opened, the resistance removed and the fuse replaced, On closing the switch the fuse must melt without maintaining an arc and without explosive violence.

§ 31. For testing with a gradually increasing load, the resistance referred to in § 30 is to be removed and replaced by the resistance mentioned in § 29, which is to be used for regulating the current strength. Fuses with normal carrying capacity up to 50 amperes inclusive, must be able to carry continuously at least 1¼ times their normal fusing current; and when switched on suddenly and loaded with double their normal current, they must melt inside two minutes.

Sicherheitsvorschriften des Verbandes Deutscher Electrotechniker.

Low Pressure Systems.

§ 12*b*. The maximum fusing current allowable with conductors of given area is detailed in the following table. Several conductors may be connected to one common fuse, provided that it has a normal fusing current of not more than 6 amperes. Fuses may also be used with a lower fusing current than that indicated in the table.

Conductor. Cross-section in sq. mm.	Normal carrying capacity of the fuse in amperes.	Fuse. Fusing currents in amperes.
0·75	6	12
1	6	12
1·5	6	12
2·5	10	20
4	15	30
6	20	40
10	30	60
16	40	80
25	60	120

Note.—This table is continued up to cross sections of 1,000 sq. mm., with a normal carrying capacity of 1,000 amperes, the fusing current in every case being double the normal carrying capacity.

(d). Fuses for conductors up to 6 sq. mm. cross-sectional area (20 amperes normal carrying capacity) must be non-interchangeable with fuses of greater carrying capacity.

Medium Pressure Systems.—For house installation work, fuses with normal carrying capacities from 2 to 20 amperes must be non-interchangeable with those of greater capacity.

High Pressure Systems.—The maximum fusing currents with conductors of given area are shown in the following table. Fuses with lower melting currents than those indicated may be employed.

Conductor. Cross-section in sq. mm.	Normal carrying capacity of the fuse in amperes.	Fuse. Fusing current in amperes.
1·5	6	12
2·5	10	20
4	15	30
6	20	40
10	30	60
16	40	80
25	60	120

Note.—This table is continued up to cross-sections of 240 sq. mm., with a normal carrying capacity of 330 amperes, the fusing current in every case being double the normal carrying capacity.

While these regulations are considerably ahead of our own, they fall short in many respects of what is desirable; they do not, moreover, represent the degree to which standardisation has been carried in Germany, as owing to the initiative of private firms, the standard ranges both for current and voltage have in practice been largely extended. The Siemens cartridge cut-outs, for instance, are standardised and non-interchangeable from 0·5 ampere to 100 amperes, and for pressures up to 500 volts.

In France the regulations in connection with fuses are not so complete; the following abstracts are taken from the regulations issued by the "Associations Françaises de Propriétaires d'Appareils à Vapeur Ayant un Service Electrique," the "Association des Industriels du Nord," and the "Association Normande pour Prévenir les Accidents":—

Cut-outs should be so constructed that on disconnection or fusion an arc cannot be maintained or the metal be scattered, or an explosion occur in the case of a short-circuit.

Up to 50 amperes the section is determined by the following conditions: (1) to be able to withstand without melting or altering, a current density of 25 per cent. above the normal. (2) To melt with certainty in not less than two minutes with double the normal current. For cut-outs of over 50 amperes the first condition is not insisted upon, but it is considered generally desirable that fusion should take place under two minutes with double the normal load.

Up to 20 amperes at least, cut-outs should be constructed so as to obviate the erroneous employment of too strong fuses, and the following current ranges are suggested : 1, 3, 5, 7·5, 10, 15, 20 amperes. The following recommendations also refer to fuses up to 20 amperes :—

1. That there should be no charged metallic part capable of being touched when in position or during removal.
2. That the replacing of the movable part by another metallic piece should be rendered as difficult as possible.
3. That the plug should be in one piece without any exposed metallic part.
4. That the replacing of the fuse cannot be effected except by competent persons.
5. That it can be easily controlled if a short-circuit occur.
6. For circuits over 250 volts, cut-outs should be constructed so that the plugs intended for lower pressures cannot be used for them.

These regulations have evidently been modelled on German lines, but are not nearly so comprehensive; they are further not universally employed, their use being confined chiefly to the northern and eastern departments.

Municipal Wiring at Sheffield.—The Council of the Sheffield Chamber of Commerce has received a deputation from the Sheffield Electrical Contractors' Association on the subject of municipal trading, as carried on in the electrical fittings and wiring department of the Sheffield Corporation. The electrical traders are substantial ratepayers of the City, and by reason of the municipal competition to which they are subjected, they have convinced the Council of this Chamber that it is impossible to carry on their business. The Council has recorded its disapproval of the City Council's carrying on this department with public funds, and recommends that a copy of the resolution be forwarded to the City Council in the name of the Chamber, and a copy of the same be given to the Electrical Contractors' Association for their use in the legal opposition they are pursuing.

THE ZAMBESI POWER SCHEME.

By W. B. ESSON, M.I.C.E., M.I.E.E.

The utilisation of the Victoria Falls for the purpose of transmitting power electrically to the Rand is no new scheme, though only recently has it been brought prominently before the public. Whether the project is feasible from an engineering point of view, or, if so, on what lines it had best be carried out, are questions which are of the greatest interest to scientific men ; the question, however, which is of paramount interest to the investor who puts up his money is—Will it pay?

The scheme now proposed by Mr. H. Wilson Fox, the manager of the British South African Co., in *South Africa*, embraces duplicate transmission lines 700 miles long. The conductors are to be of aluminium, and the insulators are to be supported on braced steel towers about 60 ft. high spaced half a dozen or so to the mile. The construction of these towers is to be similar to that of the towers used in the Guanajuato transmission in Mexico, but the spans proposed are twice as long, the Guanajuato spans being 448 ft. It is calculated that the requirements of the Rand may amount to 150,000 H.P., but the promoters are prepared to make a start with an installation capable of delivering a maximum of 20,000 H.P.

The proposed pressure on the transmission lines does not appear to have been published, but obviously it would be unwise to attempt anything very much higher than what we already have experience of. The highest pressure at present in use for three-phase work is 60,000 volts, though a line is under construction to work at 67,000 volts, and, in two new schemes, provision is being made for apparatus which will stand 80,000 volts. The idea in the last two cases is, that whenever a line insulator appears which can be relied upon to work at 80,000 volts through all kinds of weather, the pressure will be raised accordingly. Though pressures of 60,000 volts are no longer experimental, they are not yet free from troubles, and it would be injudicious, to say the least, to depart in a scheme of such magnitude, from the lines of experience. As the constant current system of Thury seems to be favoured by the promoters, we shall assume for argument's sake that a pressure between the conductors at the generating end of the line of 100,000 volts is permissible. This pressure, so far as the strain on the line insulation is concerned, is equivalent to about 60,000 volts on the three-phase system.

It is always difficult to predict the number of units which will be demanded annually from a power house, for each KW. of capacity. In his paper recently presented to the British Association at Johannesburg, Mr. R. Hammond assumed that the average of the consumers' load factors on the Rand would be 40 per cent., which is equivalent to working their machinery at full capacity for 3,500 hours annually, certainly a reasonable assumption. The diversity factor he took to be 60 per cent.,* which I consider rather too favourable for the scheme, but, as the figure has been given, I will, for argument's sake, keep to it. According to this, a 20,000-H.P. installation will supply power to 33,300 H.P. of motors fixed, and this latter running at full load for 3,500 hours gives us, say, 87,500,000 units per annum. In estimating the chances of any new project, it is necessary to assume *some* figures, and these should be fair according to the best of our judgement ; we should take neither too sanguine nor too depressing a view of the possibilities, and what will apply for the steam station which Mr. Hammond advocates will, of course, apply for a hydraulic station.

To judge of the merits of the scheme, it is necessary to find the amount chargeable to each unit by reason of its having to be transmitted over 700 miles and then suitably transformed for distribution to customers. It is proposed to work with a loss of 25 per cent. in the line, and the waste in the transforming machinery will bring the total loss up to 33 per cent. We may therefore say, in round figures, that of the power put into the line at the Falls one-third is wasted. It must be clearly understood that, as regards the cost of the conductors, there is no room whatever for difference of opinion. Given the distance, the power to be transmitted, the power which it is permissible to waste in the line and the pressure, and there is a certain weight of conductor which must, with the system referred to, be used to meet these given conditions. By no possible means can this weight be reduced by a single pound, and the metal market quotations settle the price. In the interview, published in *South Africa*, Mr. Wilson Fox tells us that each of the duplicate lines is to be capable of transmitting the whole of the power. Hence, to receive 15,000 KW. at the mines, we have to put into either line at the generating station 22,500 KW., which, at a pressure of 100,000 volts, corresponds to 225 amperes. With the data before us, it is easy to work out the weight, and a simple calculation shows that the aluminium in the conductors for this 20,000 H.P. scheme will run out at 9 tons to the mile. This makes the total weight of wire 6,300 tons, and at £177 per ton—the price of aluminium to-day—the cost works out to £1,115,100.

The cost of the steel towers is not fixed like the cost of the conductors, but depends upon the design. I have, however, made some calculations with regard to these and the insulators, and my conclusion is that, having regard to the character of the country, the total cost of the 700-mile double line will be about £2,000,000 sterling. This is, of course, a large figure, but it is nothing to be frightened at if a fair return will be yielded on the outlay. By the sale of energy this return must be obtained, and we must also derive from the same source enough to pay for the cost of up-keep. If we take the return on capital at 5 per cent. per annum, and assume that maintenance and renewals will require another 5 per cent., we must get 10 per cent. on £2,000,000, or £200,000 to pay for the transmission, this constituting a charge to be spread over the 87,500,000 units. From this we perceive that on account of the cost of constructing a transmission line 700 miles long, each unit delivered from the transforming apparatus at the Rand must be charged with nearly ·55 of a penny, or something over a half-penny per unit.

It has been stated that the larger the installation the lower will be the capital cost per horse-power. This, as a general statement, is quite correct; but it is to be interpreted as regards the line in a somewhat different way than as regards the other parts of the plant. For the same percentage of loss, the weight of the conductors actually in use to transmit the power must be absolutely proportional to the amount of power transmitted, but whereas in the 20,000 H.P. scheme the cost of the spare line is 50 per cent. of the total, in the 150,000 H.P. scheme it need not be more than, say, 20 per cent. It is only in so far as the percentage of spare can be reduced in the larger scheme that any saving per horse-power in the conductors can be effected. The cost of the steel towers will also be relatively less in the 150,000 H.P. scheme, and it is not unlikely that when this latter is in full operation the total amount chargeable to each unit, in respect of the line, will be reduced to ·3 of a penny, or even less.

The above represents only one item of the capital cost, and there are the generating plant at the Falls and the transforming plant on the Rand to be taken into account. As regards the former we have to remember that, owing to the losses in the line and transforming plant, the capacity of the turbines and generators has to be one-half larger than that of the motor-generators. I have seen no estimates of these costs, but they will necessarily depend to a large extent on the nature of the hydraulic works to be undertaken. Judging from other power schemes, however, and having regard to the system to be used, £15 per KW. installed, for the hydraulic works and power house complete, would seem a probable figure, while for the transforming houses complete, £8 10s. per KW. installed would also appear about right. This gives us £337,500 for the power house, and £127,500 for the transforming houses, or £465,000 together. If, as before, we ask a return of 5 per cent. on the capital outlay and assume that the average cost of maintenance and renewals will be met by another 5 per cent., making 10 per cent. in all, we get a further amount of £46,500 to be spread over the 87,500,000 units delivered annually. This comes to nearly ·13 of a penny, and taken with the amount of ·55d. chargeable in respect of the line, brings the total capital charge to ·68 of a penny per unit, for energy transformed

* The figures of 40 per cent. and 60 per cent. taken together give the equivalent of a 66 per cent. load factor on the bus-bars.

ready for distribution to the users, but without taking into account the cost of the distribution lines. When we add interest on the cost of the distribution lines, also maintenance and renewals, include the cost of oil, stores and wages at the generating and transforming stations, and allow for the expense of administration, it appears that even on a 20,000 H.P. scale the cost of power to the consumers need not exceed about ¾d. per unit.

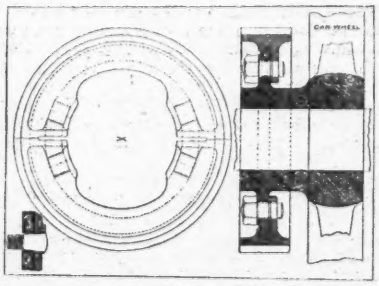
On a further calculation, if the capacity of the undertaking were increased to 80,000 H.P., which is about the capacity of the steam installation suggested by Mr. Hammond, it looks as if the costs would come out lower than in any steam installation that could be put down. The figures assumed in this article are, of course, incomplete, and subject to modification, as accuracy could only be arrived at after a large amount of preliminary work had been done. But they clearly show that there is nothing in the proposals put forward by the promoters to justify wholesale condemnation of the scheme. Amongst other things, far too much has been made of the matter of patrolling the line. Two American companies already patrol 700 miles and 1,000 miles of line respectively, running over the roughest country in the world, and with their well-trained staff of patrolmen it doesn't worry them at all. The experienced transmission engineer does not count as difficulties matters of this kind, and if better arguments cannot be brought forward against the scheme, it is not in much danger.

GEAR WHEELS.

Until quite recently nobody thought of departing from the standard split gear—at all events, nobody did depart from it. It was universal, and, as it was well made, it gave general satisfaction; but for some years past many tramways have been plagued with broken axles.

We have alluded to this before, and we mentioned the key-ways of these split gears as being responsible, together with several other things.

Almost without exception, axles break at the end of the key-way next the wheel, this being the weakest section, and the question at once presents itself, Would breaks occur at all, if the key-way were not there? Spencer, of Halifax, and a few more thought so, and tried a gear cast machined in one piece. This was bored and pressed on to the axle just like the flanged wheels, and it was found that the maximum driving effort did not shift it. The removal of the key-way was not the only advantage gained, for the new wheels



A Novel Two-Piece Tramway Gear and Hub.

could be made more cheaply than the split wheels, and there were no bolts to come loose, and drop, as they sometimes did, into the teeth, where they played sad havoc, even to the extent of bending the armature spindle.

There can be no doubt that the solid gear has saved axles from breaking, and it has been suggested that they are of some value in this way when pressed on to axles which have been key-wayed. In this case it is considered better to fill up the way with a well-fitted steel insertion.

The pressing on and off of these solid gears presents no difficulties which cannot be overcome with a small expenditure of time and money, and in most repair shops appliances which will do the work, are to be found ready to hand. When cast-iron running wheels are used, there do not seem to be any disadvantages in the solid gear, except that the wheel next the gear has to be pressed off when the gear is worn out, and it is doubtful whether it will go on again tightly enough without resort to the objectionable practice of roughing the axle round the wheel seat. Probably then the removal of the gear carries with it the removal of both the wheels on that axle, as a new and old wheel cannot be run together.

Of course, it may happen that the gear and the wheels are all fit for scrapping nearly at the same time, in which case this objection does not apply. After all, the life of a gear-wheel is somewhere between two and three years, and the rather theoretical objection which we have raised, is nothing in comparison with the immunity from broken axles.

It is when steel-tired wheels are used that the solid gear is at a disadvantage, for in that case the wheel centres are pressed on once and for all, and it would not be at all desirable to press them off even at intervals of two or three years, even if it were possible to put them on again at the same pressure.

It is this drawback which has prevented the solid gear being taken up as much as it deserves.

An English firm supplies these gears in cast steel with the teeth left just as they come out of the sand, and, contrary to expectation, they run as smoothly as the machine-cut teeth of a split gear, while the advantage of the extra life given by the extremely hard skin is gained.

In order to satisfy the objection to pressing off the gear at any time, one firm supplies a form which is made in two parts, the centre, cast in one piece and pressed on to remain until the axle is discarded, and the rim, which is bolted to a vertical flange on the periphery of the centre casting. This deals with the main trouble—the key-way—just as effectively as the one-piece gear, but it re-introduces the bolts. On the other hand, while it is little, if any, more costly than the one-piece gear, it certainly costs less afterwards, as only the rim has to be renewed. Probably this cheapening of renewals, will lead to the rims being scrapped before the teeth are reduced so much as they are on the split or solid gears, and that will make for less noise and longer life for the pinions.

In addition to the two-piece keyless gear just mentioned, we find the *Street Railway Journal* for October describing something which is the same in principle, but still more novel in design. From the illustration below it is seen to be composed of a toothed rim, which is bolted on to an extension of the hub of the running wheel. That appeals to us as an eminently practical arrangement where cast-iron centred steel-tired wheels are used, as there must be an economy in both material and labour.

Where cast-iron wheels are used the extended limb has no advantages over the separate hub.

Every engineer who is using split gears should go into the question of pressed-on gears for himself. Our experience leads us to say with some confidence, that a careful investigation will result almost invariably in the discovery that money can be saved directly by the gradual substitution of pressed-on keyless gears for split-keyed gears, while indirectly the saving will be in proportion to present trouble with axles.

It is not to be supposed that this substitution is guaranteed as an absolute prevention of broken axles. While there is no doubt that axles are fractured earlier by reason of the key-way which is required with split gears, they will fracture sometime, but later, when there is no local weakening in the design.

A steel bar will withstand only a certain limited number of shocks before re-arrangement of its particles reaches the point at which it can no longer stand up to its load, and every axle will follow this law irrespective of the method of attaching the gear wheel.

But it has been shown over and over again that a steel bar may be rejuvenated, that its go-as-you-will particles can be forced to return to their proper positions by a carefully performed heating and annealing.

Considering the widespread trouble which has visited tramways, in which axles have been running for several years, and have then broken down, it is somewhat remarkable that no firm or individual has put on the market an annealing plant suited for the tramway workshop.

If any of our tramway readers have adopted this principle for lengthening the lives of their axles, we shall be glad to have particulars of the process, and any information which proves its efficacy. The method has been applied in railway shops, and ought to be just as useful for tramcar axles.

INSTITUTION OF ELECTRICAL ENGINEERS' DINNER.

On Friday last, the seventeenth annual dinner of the Institution was held at the Hotel Cecil. Mr. John Gavey, C.B., the President, occupied the chair, and there were present about 400 guests, including the Rt. Hon. Lord Strathcona, Sir G. S. Clarke, Major-Gen. Sir A. E. Turner, Sir J. W. Swan, Sir George Murray, Sir Norman Lockyer, Sir A. R. Binnie, Sir W. de W. Abney, Sir J. C. Lamb, Sir C. Owens, Col. Sir H. Jekyll, the Hon. Sir W. Arbuckle, Sir Henry Tanner, Sir Robt. Hunter, Lieut.-Col. H. A. Yorke, Brig.-Gen. R. M. Ruck, Capt. A. M. Field, the Hon. J. G. Maydon, Rev. Dr. J. Gow, Prof. Dr. E. Budde, Prof. R. Meldola, Mr. H. H. Cunynghame, Mr. C. A. Cripps, Mr. T. S. Kelley, Mr. H. Babington Smith, Dr. T. E. Thorpe, Mr. T. R. Price, Mr. J. Young, Mr. C. Hawksley, Mr. A. B. Kempe, Mr. J. A. F. Aspinall, and many other distinguished gentlemen, besides the members of council, and ordinary members with their guests.

After the loyal toasts, the toast of "The Institution of Electrical Engineers" was proposed, in the absence of Mr. R. W. Perks, by Mr. H. Babington Smith, secretary of the G.P.O., who remarked that the Post Office was one of the earliest clients of the Institution, and had supplied it with many presidents before its present

engineer-in-chief. He paid a warm tribute of esteem and affection to Mr. Gavey, and expressed the satisfaction of his friends in the Post Office at the honour which had been paid to him. The Institution had existed for a whole generation, and in that space enormous advances had been made in electrical science, but he thought that in the next generation equally great strides were possible and probable. In his reply, Mr. Gavey recalled the days, 50 years ago, when electrical engineering was represented only by the telegraph engineer, the unit of resistance was a mile of copper wire, the unit of E.M.F. a Daniell cell, and the unit of current no one knew what. The admirable system of units afterwards evolved in this country was discovered and adopted 15 years later by the world, without much acknowledgement of its origin. Since then the importance of electrical science had developed to such an extent that soon it would form an integral part of every engineer's curriculum.

Sir A. B. W. Kennedy proposed "The Electrical Industries" in a humorous speech, distinguishing between industries *and* industries, and congratulated them on the fact that they had become of national importance, and were financially on a sound foundation. They had kept themselves in close contact with the latest progress in physical science, and indeed there was no other industry which had done so much towards the advancement of the science on which it was based. He eulogised the work of Mr. Cunliffe Owen in connection with the Electrical Exhibition at Olympia, and concluding with warm greetings to Dr. Budde as the representative of the German electricians, he said he hoped that Dr. Budde had not come to reproach them for stealing Prof. Kapp—it would be useless, for they meant to keep him.

Mr. E. Cunliffe Owen responded, and attributed the success of the Exhibition to the efforts of his colleagues and the exhibitors, but also largely to the support of the Institution. He apologised for the defective arrangements for the lectures given by members of the Institution, due to the enthusiasm displayed in the cookery demonstrations. The accounts had not yet been issued, but 25 per cent. of the rentals would be returned to the exhibitors, and the two benevolent funds—that of the Electrical Manufacturers' Association, and that of the Institution—would benefit by the surplus, the latter to the extent of £250.

Dr. Budde (president of the Verband Deutscher Electrotechniker) communicated the cordial greetings of the German electricians whom he represented to the members, and remarked that the Institution, which had been the first to go abroad to inspect foreign works, had now returned the compliment of invitation to its foreign friends. He thought that science and technics could not be too closely associated; intellectual labour and research formed a bond drawing together all the best spirits in the world. The Germans cordially admired their English colleagues, to whom they were indebted for the locomotive and the steamboat. They would hear with pleasure the words of Sir A. B. W. Kennedy.

Mr. Alex. Siemens proposed "Our Colonies," and referred, at some length, to the pleasant experiences of the British Association in South Africa, to the cordial goodwill and kindness there met with, which, he knew, were manifested also in Canada and other British Colonies. Replying to the toast, the Hon. J. G. Maydon (Minister of Railways in Natal) said that the Mother country saw in her children beyond the seas her own youth renewed; not a colony or a colonist but was proud of his descent, and devoted to the flag. The greatest danger lay in too much wealth being accumulated in Great Britain, resulting in contentment with things as they are. Not in South Africa alone, but in the whole Empire the dominion of Great Britain was at stake five years ago; since then enormous progress had been made in the South African Colonies, which he hoped would in their own lifetime be federated.

Mr. W. M. Mordey proposed the health of "Our Guests," and referred especially to the railway men, to whom he recommended electrification as the cure for the tramway competition complaint. The fact that no power station gave out more than 5 per cent. of the energy of the coal put into it showed that the help of men of science was badly needed—there were many problems awaiting solution. Sir Alex. Binnie (President of the Institution of Civil Engineers), in reply, said that electrical engineers had done more than any others to promote harmony between the nations. Steam did much, but electricity brought the minds of men into closer communion, forming a great congress of human beings who all ought to do good to one another.

The company then adjourned to a reception room, where they were able to converse at ease. During the evening the Imperial Orchestra, under Mr. A. Crudge, performed a programme of music, and the proceedings were in every way successful.

LEGAL.

Victor Coates & Co., Ltd. (Belfast) *v.* Law Accident Insurance Society, Ltd.

At Belfast last week Mr. Justice Gibson and Mr. Justice Kenny had before them this arbitration. According to a Belfast newspaper, the defendant company had insured a large engine, erected by Messrs. Coates at Newcastle-on-Tyne, for the Corporation electrical station. A question arose whether certain works required to be carried out during the trials of the engine and afterwards, came within the clause of the policy and were to be borne by the insurance company or by Messrs. Coates. Having failed to agree on an arbitrator, the King's Bench was invoked to appoint one under the Irish Common Law Procedure Act, but the insurance company sought to discharge an order making the submission to arbitration a rule of Court, on the ground that the Court had no jurisdiction. The Court, after hearing the arguments, suggested that, as the matter must come to arbibration, the parties might agree on the selection of an arbitrator, the case meanwhile to stand out of the list.

Dickinson & Co., Ltd.

In the Chancery Division on Friday Mr. Dunham applied to Mr. Justice Joyce for the appointment of a receiver and manager of Dickinson & Co., Ltd. The learned counsel stated that his client held the whole of a series of £500 debentures in the defendant company, which carried on business as electrical and mechanical engineers in London. The principal became due on December 31st, 1904, and no interest had ever been paid. In November a petition to wind up the company was presented, and it would be heard next week.

Mr. Justice Joyce appointed a receiver and manager as asked.

Davies *v.* Spagnoletti & Co.

This case came before Mr. Justice Channell, sitting without a jury, in the King's Bench Division, on Thursday last week. Mr. Newbolt appeared for the plaintiff, and Mr. McCall, K.C., and Mr. J. C. Graham for the defendants.

Mr. Newbolt, in opening the case, said that the defendants were contractors and manufacturers of electrical appliances, and agents for the Rex Fire Extinguishers, and on July 9th, 1901, an agreement was made by which the defendants engaged the plaintiff to sell the extinguishers, and also to obtain manufacturing orders for electrical work. The terms between the parties were arranged by a letter written on July 9th, 1901, and at an interview which followed. The plaintiff's case was, that in pursuance of the contract the plaintiff introduced to the defendants six or seven firms who gave them orders. Amongst these firms were the British Thomson-Houston Co., Messrs. Blackwell & Co., and the Great Central Railway Co. By the statement of claim, plaintiff alleged that defendants had refused to pay him any commission after November, 1904, and had not rendered him any account of sales. In February, 1905, the plaintiff received notice from the defendants terminating the contract. Plaintiff accordingly claimed a declaration that he was entitled to commission as to the defendants' dealings with his customers by reason of the employment, and for those that he had introduced after he was dismissed without notice. By the defence, the defendants alleged that up to February 28th, 1903, there had been a settlement; but the defendants did not allege that the plaintiff had any accounts. Defendants further said that on January 14th, 1904, they paid plaintiff £17 18s., which was admitted, and then they said that they had delivered an account containing a complete statement of all sales of the defendants' fire extinguishers and for manufacturing orders. Defendants also raised the curious defence that the manufacturing orders were at such a price that defendants could not afford to pay any commission. Defendants further said that plaintiff sold nothing after February, 1903, and they paid £30 into Court in respect of the past commission due, and the plaintiff's right to future commissions. The learned counsel said that the plaintiff for years past had been engaged in electrical work, and about 20 years ago was a partner in an important company called Laing, Wharton & Down. After he severed his connection with that company, he felt capable of introducing work to the defendants, and so entered into the contract in question.

The Plaintiff gave evidence in support of his counsel's statement, going in some detail through the accounts with the defendants.

In the result his Lordship, after hearing the evidence of the defendant and his manager, held that the plaintiff was entitled to £30 commission, but as the defendants had paid this amount into Court, judgement was entered for the defendants, with costs.

Timperley *v.* Burnley Corporation.

At the Burnley County Court last week, defendants were sued for £50 damages, alleged to have been caused, by the negligence of one of the Corporation's electric car drivers, to the van of a baker and confectioner. The case for the plaintiff was that on September 5th his man had been delivering goods at a shop in Westgate, and prior to re-entering the van he looked up and down the road to see if it was clear. At that time there was no electric car in sight, but when the horse had walked 10 yards a car crashed into the van and jammed it against an iron pillar, smashing it, and throwing the driver into the road insensible. When the driver had recovered somewhat the car driver, it was alleged, came up smiling, and remarked that he thought he could just pass the van before it got to the pillar. For the defence it was contended that the van was at a standstill till the car got level with it, and then the horse started off, swerved suddenly, and the front part of the van collided with the tram. The back part of the van was not touched. There were a number of witnesses called on both sides. His Honour Judge Bompas said there seemed to have been equal negligence on the part of the drivers, and under the circumstances he thought the plaintiff could not recover. He would give judgement for the Corporation

THE MAYOR, &c., OF CAMBRIDGE *v.* THE NATIONAL TELEPHONE CO.

IN the Chancery Division on Saturday before Mr. Justice Joyce, Mr. Pattison said he moved on behalf of the Corporation of Cambridge for an order to compel the National Telephone Co. to remove certain poles and standards for carrying telephone cables and wires in Cambridge. The defendants had appeared to the action, but the matter now came on as a motion for judgement in default of defence, and defendants were not represented by Counsel. Within the borough of Cambridge there were a number of these poles and standards, which were erected under a terminable licence from the plaintiffs. Notice to terminate the licence had been given. The statement of claim alleged that the necessary notice had been given to the defendants, but the poles and standards had not been removed. He therefore asked for an order to compel the defendants to remove these things.

His LORDSHIP said that the plaintiffs could have an order that the defendants do remove the poles and standards within 21 days.

Mr. PATTISON said plaintiffs would be content with an order that the poles should be removed within a month.

His LORDSHIP said he wished he could make the Telephone Co. pay, but he was not sure whether the plaintiffs had sustained any damage. An inquiry as to damages would bother the Master very much.

Mr. PATTISON said he would not insist on the inquiry.

His LORDSHIP made an order for the removal of the poles within a month, the costs up to and including judgement, to be taxed.

SWANSEA CORPORATION *v.* NATIONAL TELEPHONE CO., LTD.

(APPEAL).

LORDS JUSTICES VAUGHAN-WILLIAMS, Stirling and Cozens-Hardy have this week been hearing the appeal of the defendants in the action of the Mayor, Aldermen and Burgesses of the Borough of Swansea *v.* The National Telephone Co., from a decision of Mr. Justice Buckley.

Mr. ASTBURY, K.C., who appeared with Mr. Danckwerts, K.C., and Mr. Gay for the appellants, said this was the first case that had come up for decision under the new Act of 1899, which gave to a borough council the right, if it could obtain a licence from the Postmaster-General, under certain circumstances to compete in the area of the borough with the Telephone Co. on certain terms. The Telegraphs Act shortly provided this: that if certain conditions were complied with on both sides, a borough council could obtain a licence for telephones within its own area; that, on the Telephone Co. consenting to certain conditions being inserted into their licences, the licences should be extended for the period for which the Postmaster had granted the new licence to the Borough Council; and that, on certain further conditions being complied with, the borough council might ask the new licensee to apply for what was called restricted intercommunication. In this case the Borough of Swansea had obtained a new licence until 1920, and had now called upon the Telephone Co. to give, as the Act called it, "reasonable facilities" for what it described as "restricted intercommunication." All that it meant was really not that one system should be joined to the other, which was the view that the judge below had taken, but that subscribers to one system should have an opportunity of communicating with the subscribers of the other. This was the first time this had occurred, and, of course, it was quite possible that it might happen in a great many other places. It was of extreme importance to the company that they should see that these facilities were given in such a way as would not disintegrate and ruin the system which was asked to give the facility. The directors of the National Telephone Co. were a considerable body of men, many of whom occupied very high positions, and this particular case was one of vast importance to them, because if Mr. Justice Buckley's construction of the Act were correct, the company's business throughout the country, if other cases arose in any numbers, would be lamentably disintegrated. The learned judge, he thought, had assumed that he was entitled to judge of what was the class of facility that they should give. There were many ways in which this might be done. It was the most complicated class of work of this nature that could possibly be conceived. A telegraph office was nothing to it. There were three great telephone systems known, the Western of America, the Swedish system, which was very largely used in this country, and the system that the National Telephone Co. had hitherto adopted, which was more or less a combination of the two. The different systems were worked in different ways with different sorts of battery connections. Assume that the Corporation had started a system and demanded intercommunication. All that the Act said was that when that demand was made the company was to give reasonable facilities. It provided that within six months of the passing of the Act the Postmaster-General might, by general order, lay down the circumstances and terms and conditions upon which such facilities should be given. Whether he was unable to do it they did not know, but he did not do it. He made a general order, which added nothing to the Act at all, and it did not prescribe any mode or term or condition which was to be complied with. Supposing there were five well recognised modes in which these facilities could be given, and that three out of the five were modes which would disintegrate and cause great confusion and difficulty in their working. Supposing that the two other modes would give the Corporation exactly the same facilities without costing the company all this trouble and inconvenience, and supposing that the directors of the Telephone Co., as they had done in this case, met and discussed it, took the very best expert opinion they could get, and came to the conclusion that they would allow it to be done in one of the two ways that they thought would alone do it efficiently and without unnecessary disturbance, and without interfering with their obligations to their own subscribers. In that case the Court could not, would not, and ought not to interfere, because it had been laid down for years and years past that where a body had to give reasonable facilities for a certain thing which could be done in various ways, the choice of the right way was left with the person who was called upon to give the facilities. The Corporation had demanded that they should do a particular act, and that act only. They demanded intercommunication in a particular way and by a particular means, which the company said would destroy both systems, and in the honest exercise of their discretion and their powers, they had come to the conclusion that that was not a proper way of giving facilities. The learned Judge had taken upon himself the jurisdiction to hold that he was entitled under this Act to say what reasonable facilities were, and how they must be given, to this extent—that he had expressed himself extremely strongly in favour of the Corporation's demand, and he had gone so far as to hold that the facilities which the company had offered amounted to a refusal to give any facility at all within the meaning of the Act. The directors of the company felt this very much. They had done what they held to be their very best in deciding in what way these facilities were to be given. The Corporation did not say that what the company proposed would have any pernicious effect. They admitted that it was the best, but said it was too expensive. They did not deny that that system when in operation would give the best possible results, and they admitted that what the company proposed might have to be done at a later date, but at the moment they said they were entitled to have partial communication between the exchanges and to compel the company to take their messages through various exchanges instead of direct to their subscribers. The Corporation wanted it done in a rough and ready and bad and faulty way, admitting that it would have to be altered as time went on and as more subscribers came in. The company wanted to do it in a way which would once for all make it perfect and enable them to comply with their obligations. If their Lordships came to the conclusion that what they had offered to do was not only reasonable, but was the only sensible way of doing it, based upon their experience of very many years, then unless they could hold that that was a refusal to give facilities, their Lordships would not take upon themselves jurisdiction to order them to do something else. That was where their jurisdiction did not come in. The company had 12 exchanges in Swansea, and the Corporation had now five. They said that all they were bound to do was to bring a great bundle of cables up to the company's central exchange and demand that the company should put them on to the switchboards. Then they said that if any of their subscribers wanted to telephone to any of the company's exchanges, the company would have to do that—lay the necessary junctions, and do the necessary work to take their messages through the central office. They treated it as if each system had a large mouth, and all they had to do was to pour their messages into the mouth of the company's system. The company, on the other hand, said the Corporation must carry their message up to the switchboard to which their subscriber was connected. The learned Counsel said he could not see how the learned Judge could say that the National Telephone Co. were trying to put on the Corporation of Swansea unnecessary obstacles. Whatever the Telephone Co. wanted the Corporation to do, the company were willing to do exactly the same. The Act said that the Telephone Co. were to give reasonable facilities for the Corporation's subscribers to speak to the company's, and the Act also said that the Corporation were to grant the same facilities.

During the learned counsel's argument Lord Justice VAUGHAN-WILLIAMS, addressing Mr. Buckmaster, asked if the question to be decided was not very much one of expense.

Mr. BUCKMASTER: If you only see what the Judge has ordered it is very difficult to see what they are appealing from. The Judge has merely declared that we are entitled to certain things, and that certain things shall be done, and that if in the course of working, certain things he has described are necessary, there shall be liberty to apply.

Lord Justice VAUGHAN-WILLIAMS: At the bottom is it not really a question of costs?

Mr. BUCKMASTER: And delay. One thing is certain: if there is anything further to be done to render this thing effectual, there is power left open to the Court to determine it.

Lord Justice VAUGHAN-WILLIAMS: What I want to know is this. Take the Pontardulais. We are told by Mr. Astbury that if the messages from any of the Corporation stations can be sent through the telephone central to Pontardulais, that there will be, amongst other things, a necessity for a considerable increase in the junction wires between the junction and Pontardulais.

Mr. BUCKMASTER: Directly we start working, and find that it will occur, three extra wires will be laid. The only dispute between us is this. We have never disputed that, if in the course of working it will be necessary to lay further wires, we will join in the expense that they incur in laying them.

Lord Justice VAUGHAN-WILLIAMS: Will you undertake that, if for the purpose of carrying your messages additional junction wires are required from the telephone central, in each case you will pay the cost?

Mr. BUCKMASTER: The whole cost?

Lord Justice VAUGHAN-WILLIAMS: They are willing to meet you there. They are willing to pay the cost of the return wire.

Mr. ASTBURY: It would be ludicrous not to put an up line and a

down line. We have been carrying on business in hundreds of places for many years, and it is a matter of calculation. If the Corporation are able to carry it on in this way they may get hundreds of subscribers in the next 12 months. What I want to say is this: It is not a mere matter of accommodating their people at Swansea, but it is a matter of vital importance to the telephone company. If the judgement stands, Corporations all over the country would say that they would have a telephone system in rivalry with ours. We want to protect ourselves against that. Proceeding, the learned counsel said he thought that when their Lordships heard the evidence they would have no doubt where the weight of evidence lay. There was another important matter about these trunk lines. Their Lordships knew that under the Acts all the trunk lines from town to town were vested in the Postmaster-General, and they were bound to give preference to trunk messages from any town. There would be great confusion if the trunk lines became overloaded. The evidence was that their wires were overloaded at present.

Mr. Astbury continuing, read copious extracts from correspondence that had taken place between parties before the issue of the writ.

Lord Justice Vaughan-Williams: I should like to ask both sides whether we are bound to listen to this correspondence, the object of which is to show that on one side or the other there was bad blood.

Mr. Astbury said he would not proceed further with the correspondence.

Lord Justice Williams said the question they had to decide was whether the Telephone Co. had a right of selection or not. If they decided that they had, they would not take away that right even if they had made the selection in a malicious spirit.

Mr. Astbury said he did claim the right on the part of the company to make a proper selection, however inconvenient it might be to the Corporation. They desired to give reasonable facilities by the use of their operators and switchboards to enable subscribers to the Corporation system to intercommunicate with their subscribers. The system which the company proposed to introduce might be dearer at the beginning, but it would prove cheaper in the end, because it would be at once efficient and perfect, and could not possibly get out of order.

After some further discussion, Lord Justice Vaughan-Williams made a suggestion that the parties should agree that the two centrals should remain connected as they were, and that as soon as it was found by the Post Office engineer that there was a block betw een the central and any of the sub-exchanges of the Telephone Co., then there should be provided a sufficient number of junction lines at the joint expense of the borough and the company.

Mr. Astbury said that the lines they wanted most were from Pontardulais to their exchange.

Lord Justice Vaughan-Williams: What I meant was that direct wires should be put down as your people have suggested that they should be done.

Mr. Astbury: I think this will be more reasonable. I agree by way of arrangement that for the purpose of trying and testing how it should be done, the junctions between the two central exchanges shall remain. Leave them in as they are, and then if and when we find that there is a congestion which interferes with the reasonable carrying on of business between our central and any one of our sub-exchanges, we shall call in the chief engineer of the Post Office, and if he is satisfied that a block does exist then between that exchange and their exchange, there shall remain these two things at the joint expense. I will agree to that, and provided that it is agreed that Mr. Justice Buckley's judgement is reversed, I am willing to pay my own costs both here and in the Court below.

Lord Justice Vaughan-Williams: I suppose we may discharge the judgement instead of reversing it?

Mr. Astbury: Oh, yes.

Mr. Buckmaster said that he could not consent to the suggestion. Up to a certain limit the judgement of Mr. Justice Buckley provided precisely what his Lordship suggested. The learned judge gave liberty to either party to apply to the Court if it was found that there was really any difficulty as to the connections. The whole point of the thing was to try these connections at their exchanges.

Lord Justice Vaughan-Williams: It is quite plain, as the judgement stands, that the only thing that will happen will be a consideration of what work is necessary to carry out the intercommunication on the basis asked for by the Corporation.

Mr. Buckmaster said that he feared the Court did not really appreciate the position of the Corporation.

Lord Justice Vaughan-Williams: If you take the position that wherever any works are required—additional wires and switchboards—they are to be paid for exclusively by the company, you are quite right in not agreeing to anything.

Mr. Buckmaster said he did not ask any such thing.

Lord Justice Vaughan-Williams said that up to a certain extent he thought that additional wires were necessary, and that the expense should be shared.

Mr. Buckmaster said he could not accept the suggestion.

Mr. Astbury then continued reading the evidence given in the Court below.

Mr. Danckwerts, following on the same side, said the last thing the company could be accused of was suggesting something which was unfair and unreasonable, or of not regarding the true interests of the subscribers. What they did was, mechanically and from a business and an economical point of view, the best.

The hearing was adjourned.

(To be continued.)

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Slovenly Business Methods.

I see in your issue of this week a letter signed "Borough Electrical Engineer," pointing out the trouble he has experienced through communications, intended for his department, being addressed only "Corporation of ———," and taking a long time to filter through the various departments before they finally reach his hands.

I had the same trouble for years, more particularly with invoices and accounts, and had the following stamp made, which is stamped on all orders :—

ALL INVOICES AND A/CS MUST BE
ADDRESSED TO THE ENGINEER.

This stamp has done splendid work, and a modification of it would no doubt be helpful for "Borough Electrical Engineer."

C. M. Johnston, M.I.E.E.,
Borough Electrical Engineer.

Shrewsbury, *December 11th*, 1905.

Please accept my thanks for publishing my few remarks last week on the question of addressing letters. I would like to add a few further remarks this week on another point which has already cropped up.

On the day you published my letter, I received a letter bearing the impress of nearly all the corporation departments, addressed to "The Engineer, —— Corporation."

Now, I would ask you, Mr. Editor, if any sensible firm expects a letter, addressed like that, ever to reach the person whom it is intended for?

The following is a list of engineers connected with this Corporation :—

The consulting engineers for the new waterworks.

The resident engineer for the new waterworks.

The resident engineer for the present water supply, who is also the borough surveyor, and often termed the borough engineer.

The dust destructor and sewage farm engineer.

The gas engineer, and myself.

With this number of engineers all connected with the Corporation, your readers will easily see how utterly impossible it is for letters to reach their destination without unnecessary delay, and although the firms, whose letters are addressed in this way, have to take the responsibility, I really believe that the fault is due to some unimportant little member of the staff, who is too much engrossed with other details to pay sufficient attention to his work.

If it is a matter of saving time, the address of any corporation electricity works can shortly be written in three words, *i.e.*, Electricity Department ——, or the other way would be to address the letters to the engineer by his own name, as all corporation engineers are too well known by the postal authorities in each town, and the public as well, for letters to get very far astray, when so directed.

Borough Electrical Engineer.

Milan International Exhibition, 1906.

But few persons in this country realise the importance of the Milan Exhibition, to be opened next spring, as a great commercial opportunity for manufacturers. I learnt during a recent short visit to Milan that our Continental competitors are still clamouring for space in addition to the large areas they were wise enough to reserve a long time ago, when the prospects of the Exhibition were very uncertain, and that they are willing to conform with the rigid and somewhat unusual rules that regulate admission, classification and arrangement of exhibits. In the meantime, indifference on the subject prevails in this country, and the prospects are that on this, as on so many previous occasions, we shall make a display unworthy of our industrial greatness, unless

there is an awakening at the eleventh hour. As reasons for abstention, our manufacturers plead stress of business; the cost and trouble involved by exhibiting; the uselessness of attempting to compete with foreign makers; the difficulties (shared in common with other countries) of trying to make business in a protected country; besides many other reasons which, not being a manufacturer, I cannot gainsay. But it does seem to me that if it is worth the while of France, Germany, Austria, Belgium and other nations, to incur the expense and trouble inseparable from exhibiting, in order to capture or increase a rapidly growing trade in Italy, it should also be worth the while of our home manufacturers to do likewise, and not to abandon a great and increasing market to other hands, at all events without a struggle. Our workshops may be full of orders, but our streets are full of unemployed who cannot be fed on the traditions of British commercial greatness.

It is not for me to decide this question; I can only record with regret our competitors' energy, and our own indifference, and express the hope that I may be wrong in my deductions.

However this may be, I can only state with certainty that the Milan Exhibition of 1906, though not half large enough for the demand upon its space, will be one of the most attractive and (in my judgement) one of the most useful that has ever been held, and that it will reflect the highest credit on its organisers and administrators.

Arthur Serena,
Hon. Executive Commissioner, British Section.

London, E.C., *December 12th*, 1905.

Cost of Gas Power.

I have been interested in Mr. G. M. Brown's contribution on this subject in your issue of the 24th ult., and my intention was, on first perusing it, to utilise it as a means of converting a certain user of power.

On further looking into the figures I think some error has crept into the cost of a gas engine for town gas and also a gas engine for suction gas plant. The cost of the former should be approximately £180 instead of £450, and the latter £300 instead of £600.

I also think that the attendance item under the suction plant has been estimated too high. It seems that some £75 per annum has been allowed for this, when half this would appear to be ample. Allowing for these two alterations it brings the comparative costs for electric motor, gas engine with town gas, and gas engine with suction plant respectively as follows :—

Electric Motor.	Engine with Town Gas.	Suction Plant.
·993d.	·854d.	·629d.

I am just as anxious as your correspondent that the very best case possible should be made for electric power, but I think great care should be taken to see that the figures utilised are quite correct.

There is no doubt that, taking the above amended figures, and assuming a poorer load factor, which in many cases is as low as 25 per cent. and under, electric driving can in many towns compare very favourably with both the gas engine and the suction plant.

P. J. Pringle.

Burton-on-Trent, *December 6th*, 1905.

Steam Meters.

I should feel very much obliged if you or any of your correspondents could describe means, if any there are, of directly measuring the rate of flow of steam in a pipe—*e.g.*, by some form of meter.

Also, what degree of accuracy may be expected from the method described, and would it be equally suitable for superheated and saturated steam?

A. S. L. Barnes.

Gibraltar, *November 30th*, 1905.

[A steam meter was described by R. S. Bayntun in our issue of February 5th, 1904; another was described in a paper read before the American Institute of Mechanical Engineers last year.—Eds. E.R.]

Compound-Wound Dynamos for Small Lighting Stations.

In the ordinary two-wire and three-wire stations (particularly small stations) with storage battery, when the intermittent working of motors is objectionable, on account of the fluctuation in lights caused by starting and stopping, would the partial compounding of the dynamo field magnets not get over the trouble? It seems to me that if the usual shunt-wound dynamos, with only a small amount of series-winding added were used, this series-winding would tend to prevent the usual fluctuation caused by the starting of, say, a passenger lift, or the working of a good sized circular saw.

Would this series winding reverse the polarity of the dynamo in the case of a short-circuit, or the momentary driving the dynamo as a motor from the bus-bars?

Where storage batteries are concerned, of course the reversal of polarity would be a serious matter.

Are not some gas-driven stations run with compound-wound dynamos and storage batteries?

I shall feel grateful if one of your readers will reply to these points.

Werdna.

Regenerative Control.

Permit me to request your unknown correspondent, "Crane," to stick to the truth when quoting from publications issued by this company or Mr. Raworth.

In his letter of last week he says :—"In letter No. 7 he (Mr. Raworth) says that the horse-power of motors *usually fitted* is altogether excessive."

On referring to letter No. 7, I find the sentence referred to reads as follows :—"A few months later I found that the power of the motors (at Southport) was still altogether excessive, so I took one motor off and put it in the stores."

The unfairness consists in founding an argument upon the interpolated words, "usually fitted."

J. Hodgson, *Secretary,*
Raworth's Traction Patents, Ltd.

London, *December 14th*, 1905.

I read in your issue of the 8th inst. that "Crane" has obtained the following "information" :—

1. "A shunt motor pounds up hill at full speed."

It does nothing of the kind—it goes up at the minimum reactive speed of the motor.

2. "A shunt motor takes an overload while working at minimum field."

This is also incorrect. It will, however, take more load than the series motor.

3. "The Spen Valley shunt motors have an awful overload forced on them by the Shoulder of Mutton Hill."

All the series motors at Spen Valley, cast from the same patterns, take the same load every ten minutes.

Let me advise "Crane" to collect his "information" instead of inventing it. I again invite him to come down to Spen Valley, where he can have every facility for doing so.

Alfred Raworth.

Great Northern Hotel, Leeds,
December 11th, 1905.

It is a pity that the space you have been good enough to allot to correspondence on the subject of "Regenerative Control" should have been so largely taken up with pointless argument, and that the critics should have been, in many cases, so careless in their statements of facts.

"Crane" seems to be the principal sinner. This is, perhaps, due to an attempt on his part to imitate the style of another. Mr. Raworth can be a humorist and an engineer at the same time, but "Crane," it would appear, has not this faculty.

Most of "Crane's" letter, published in your issue of December 8th, is too irrelevant to be fairly criticised and can hardly have any real interest for principal traction engineers.

It is not unfair, however, to refer to the statement that "Temperature rating is, of course, at full load." "Crane"

must know, if he has had any experience with traction motors, that this is not the case. Perhaps the printer has left something out. "Crane" also says, "For which condition (referring, no doubt, to full load) in neither motor (*i.e.*, shunt or series) will the field be saturated." The field of practically every standard traction motor is saturated at or about rated load, which is, and should be, considerably below full load.

The whole question is a simple commercial one. Not one, not a dozen, but scores of motors are at this moment running successfully, economically, and to the full satisfaction of the companies operating them, under regenerative control, and have been so running for many months. This is not due to any occult powers of Mr. Raworth or anyone else.

Cannot "Crane" abandon his humour and deal with the practical and commercial points under consideration?

A. K. Baylor.

London, *December 12th*, 1905.

I have read the letters signed "Crane." I have also tested a number of the regenerative cars now in operation, and I am convinced that Mr. Raworth's so-called "Goose" is really a "Swan."

"Crane" should accept the offer which has been made of a practical demonstration of the working of the regenerative control on one of the severest tramway tracks in this country.

If he will do so, I am certain he will be surprised at the progress which has been made in the working of this type of traction motor, and I feel sure he will acknowledge its great future in tramway work.

S. Sudworth.

Croydon, *December 11th*, 1905.

BUSINESS NOTES.

Imitation is the Sincerest ——. — We notice that some of our contemporaries are inserting several small advertisements taken bodily from the columns of the Electrical Review. Our advertisers will have the satisfaction of knowing that when they pay for such advertisements in the Review, they may get extra insertions in the columns of the said contemporaries gratis. But perhaps "that which costs nothing is hardly worth having."

A Storage Battery Monopoly in Germany.—The developments which have taken place in Germany in the past three years are leading to the establishment of a monopoly of the business in stationary accumulators. Until 1902 a syndicate of secondary battery makers was in existence, the combination being composed of ten firms, but the price war waged against it by outstanding firms wrecked the undertaking, and the syndicate collapsed with the result that free competition became once more the order of the day. Since then a system of concentration has been pursued by the Berlin-Hagen Accumulator Co., which has either absorbed or become associated with most other makers, so that it now controls the greater portion of the trade in secondary batteries for stationary work at the present time. The consolidation has proceeded so rapidly that only three independent firms remain. These are the firm of Gottfried Hagen, of Kalkberge, near Cologne, the recently formed Witten Accumulator Co., and the Accumulator Works (late Boese) Co. of Berlin. As far as the first mentioned is concerned, it appears that the firm has an alliance with the Berlin-Hagen Co., and it is, therefore, not a rival; the Witten Co. only has a paid-up capital of £12,500; and the Boese Co., after financial reorganisation, is endeavouring to come forward in the front rank again. As to the causes which have largely contributed towards the creation of the practical monopoly, it is mentioned that the Berlin-Hagen Co. originated in the accumulator interests of the Allgemeine Co. and the Siemens & Halske Co., and thus close relations existed between the former and the two latter companies from the beginning. When the battery syndicate was dissolved, the Berlin-Hagen Co. succeeded in concluding agreements which assured it the largest share of the German trade. The arrangements were made with the Allgemeine Co., the Siemens & Halske Co., the Lahmeyer Co., and the Schuckert Co., while to these has recently been added the Saxon Light & Power Co. It is stated that under the agreements the battery company is given a preference in tendering for accumulators required for works carried out by the electrical firms in question, and the support rendered by the latter in many cases secures the orders for the former. The importance of the agreements is shown by the fact that the group of electrical firms mentioned controls about 70 per cent. of the entire demand for stationary batteries. In return the Berlin-Hagen Co. grants these firms the maximum rebates, and in the case of orders directly executed without the intermediary of any one of the firms composing the group, a percentage on the transactions is paid over to the latter in accordance with the terms of the agreements. It will be apparent that in these circumstances some difficulty is experienced by the two outside makers of batteries in competing with the Berlin-Hagen Co. The paid-up share capital of the Witten Co. is too small to allow of its making headway against its strong rival, but the Boese Co. is agitating in the direction of endeavouring to induce consumers to divide their orders instead of placing them wholly with one company. It is stated that this agitation has been successful in many cases, although no instances are cited to substantiate the assertion.

Increased Prices of German Telephonic Apparatus.—It was intimated at the recent general meeting of one of the German telephonic material manufacturing companies that an agreement in regard to prices was being arranged. This statement has now been amplified by the announcement that the principal German firms engaged in the production of telephonic and telegraphic apparatus and appliances have been compelled, having regard to the large increase in the prices of raw materials, to advance prices of manufactures by 10 per cent. The arrangement affects the Allgemeine Electricity Co., the Siemens & Halske Co., Mix & Genest, the J. Berliner Co., R. Stock & Co., E. Zwietusch & Co. and several others. The number of small firms occupied in the same branches were not included in the negotiations which have led to the bringing about of this price arrangement, which, it is said, is also about to be extended so as to apply to the trade in storage batteries.

Consular Notes.—Balearic Islands.—According to a report of the French Consul at Palma, the population of that town amounts to nearly 75,000 persons, but the facilities for communication between one part of the town and another leave much to be desired. The only tramway line existing is five miles long, and narrow gauge with animal traction. This undertaking, exploited for some years by a local company, is very inefficient, in point of view of service, for the several districts of the town. The tramway was established with a view to communication between the town and Terreno and Puerto Pi, which are the residential districts. The speed is very low, owing to the fact that the single-track system is in use. Passengers from the residential districts are now obliged to travel by carriage to the town. It is stated that an electric system would be too expensive, but whether this be so or not the Consul is of opinion that the present system could be very much improved in new hands, or that a competing line would have every hope of success. The Consul is also of opinion that a service of automobiles connecting Palma with the various parts of the island, at present without railways, would be very successful. The Consul adds that firms would lose nothing by sending an expert engineer to study these two questions.

Colombia.—In a recent report, published by the German Government on the condition of the province of Casanare (Colombia), it is stated that as a telegraph line exists between Bogota and Villavicencio, and Bogota and Chita, it would be easy to arrange for communication with Orocue. The only system suitable would be that of wireless telegraphy. The ordinary telegraph system would be too costly. As the "Llano" is not populated, special arrangements would have to be made for inspection of the line to guard against damage by prairie fires, floods, and particularly white ants unless the posts were of iron. For the wireless system three stations at the most would be required.

Russia.—The Austro-Hungarian Consul at Odessa reports that Germany and Great Britain share the trade in steam machinery, turbines, &c., and Austria and Germany the trade in petroleum motors. The use of the latter is relatively small, in spite of the fact that fuel is cheap, but much greater trade could be done if prices were more suitable for small undertakings. Motors of German and Finnish manufacture are chiefly used for electric lighting and similar purposes. The trade in gas generators is increasing from year to year.

Condensing Plants.—We understand that the Mirrlees Watson Co., Ltd., of Glasgow, have a long list of orders in hand for condensing plants, among which are the following:—

Gloucester Corporation.—One set surface plant, duty 30,000 lb.
Moss Bay Hematite Coal & Steel Co.—One elevated counter-current jet condensing plant (in connection with blast furnace engine), duty 70,000 lb.
County Borough of Devonport.—One set surface plant, duty 25,000 lb.
County of London Electric Supply Co. (per B.T.-H. Co.).—One set sub-base surface plant for Curtis turbine, duty 29,250 lb.
North Metropolitan Electric Power Supply Co. (Willesden Station).—Two sets, each 22,000 lb., surface plant for turbine installation (repeat order).
Bentley Pits, Doncaster (per Mr. P. J. Mitchell).—Elevated counter-current jet condenser, duty 22,000 lb.
For Malaga (per Mather & Platt, Ltd.).—Elevated counter-current jet condenser, duty 23,000 lb.
For Rangoon (per B.T.-H. Co.).—Two elevated counter-current jet condensers, duty of each 15,000 lb., and one set, duty 12,000 lb.
Kearsley Spinning Co. (per Electrical Co.).—One surface plant having 3,660 sq. ft.
South Wales Electric Power Distribution Co., Cwmbran Station (per Messrs. Bramwell & Harris).—Three sets surface plant, duty each 20,000 lb.
South Metropolitan Electric Power Co. (per Willans & Robinson, Ltd.).—Surface plant, duty 32,500 lb.
Shoreditch Borough Council (per Willans & Robinson, Ltd.).—One set surface plant, duty 27,000 lb.
Beckenham U.D.C.—One set surface plant, duty 9,000 lb.

Large Lamp Rheostat.—Messrs. Pirelli, of Milan, in connection with the testing of their cables, have adopted a rheostat of 800 incandescent lamps of 110 volts placed in series, and capable of withstanding 90,000 volts in all. The lamps are connected together with bare copper wire, and a thin silk-covered wire is joined across the conductors which make connection with the lamp-holder. Normally, when the filament is in good condition, the layer of silk around the small wire insulates it from the conducting circuit, but should a filament break, the silk being subjected to a large difference of potential is burnt through, and metallic contact established, thus short-circuiting the faulty lamp.

The Charing Cross and City Co.'s Exhibition.—In our last issue we referred to the permanent Exhibition of the Charing Cross, City and West End Electricity Supply Co., Ltd., which has been opened at 85, Fenchurch Street, for the enlightenment of possible light and power consumers in the company's area. On Wednesday, in company with other representatives of the Press—technical and otherwise—we had the pleasure of paying a visit to the Exhibition, where there are, as we have already indicated, many of the latest attractions in electric light and power appliances. In the absence of the chairman of the company, Mr. F. W. Fladgate, who was attending the funeral of Lord Ilchester, Mr. G. Brougham Glasier, a director, welcomed those present, and made a few brief comments on the objects of the Exhibition, stating also that if other manufacturers, beyond those already showing, had apparatus that they desired to place in the collection of exhibits, they should communicate with the company. An appropriate quotation from Shakespeare, "And we must take the current when it serves or lose our ventures," placed on the wall in a conspicuous position to catch the eye; the convincing arguments of the company's staff; and the lessons imparted by the exhibits themselves, will combine to bring on many new consumers. Any display which brings the public into closer touch with the multifarious applications of electricity and their convenience and economy, is beneficial to the electrical industry. Here we have on a small scale the co-operation of the electricity supply authority and the electrical supplies manufacturer and trader which helped to make the Olympian show so successful. We wish the Charing Cross Co. the full reward for their present enterprise. Of the exhibits themselves little need be said here, beyond the remark that flame, arc, tantalum and other types of lamps, electric heating and cooking apparatus, motors driving various tools, electric lift equipments, air-compressing plant, ozonising apparatus, the "Solarium" light baths, and many other things that the public ought to know about, are exhibited for practical demonstration, 44 firms having lent their co-operation. The Exhibition occupies a large floor above the Fenchurch Street sub-station, which we illustrate in another part of this issue.

Dissolutions and Liquidations.—Otto Electrical Manufacturing Co. (1905), Ltd.—This company has decided to wind up voluntarily with Mr. E. H. Fletcher, 14, George Street, Mansion House, E.C., as liquidator.

The Light Railway Development Co., Ltd.—Meeting to be held at 181, Queen Victoria Street, on January 12th to hear an account of the winding up from the liquidator, Mr. David Williams.

Tram Seat Improvement Co., Ltd.—This company is winding up voluntarily, with Mr. Henry Baker, 16, Booth Street, Manchester, as liquidator.

Patent Regenerative Furnace Co., Ltd.—This company is winding up voluntarily, with Mr. W. H. King, 13, Basinghall Street, E.C., as liquidator.

Imperial Electric Lamp and Battery Syndicate, Ltd.—This company is winding up voluntarily, with Mr. Arthur Sissons, Gresham House, E.C., as liquidator. Creditors are to send particulars of their debts, &c., to the liquidator by January 15th.

Ingersoll-Sergeant Drill Co., Ltd.—This company is winding up voluntarily, with Mr. A. Burbury, 144, Leadenhall Street, E.C., as liquidator.

Wimshurst, Hollick & Co., Ltd.—This company has resolved to wind up voluntarily, with Mr. Wm. Cash, 90, Cannon Street, E.C., as liquidator.

Bankruptcy Proceedings.—John Sampson Robson.—At Newcastle-on-Tyne Bankruptcy Court on December 7th, the examination of John Sampson Robson, electrical engineer, particulars of whose affairs have already appeared in the Electrical Review, was closed.

J. W. Smith (Smith & Co.), electrical engineer and contractor, Darwen. First meeting, December 18th; public examination, January 10th.

William Leslie, electrical engineer, Putney (present address, H.M. Prison, Brixton).—Receiving order made December 7th on creditors' petition. Also a similar order against Alice Frances Cheeseman, of the same address.

Trade Announcements.—Messrs. Cutting Bros., dynamo and motor manufacturers, ask that all communications should be sent to them at their new works—Park Works, Stamford.

Mr. A. H. Hunt, of 115/117, Cannon Street, E.C., has taken over the sole British agency for the Hellesen dry cells from the former agents, Messrs. Fuller, Macleod & Co., Ltd. Mr. Hunt wishes it to be known that this well-known dry cell can be supplied from London stock. He has in circulation lists showing and pricing the cells for ignition, telephony, telegraphy, bells, testing, and various other purposes.

A.B.P. Accumulators.—The following orders have been booked by the A.B.P. Accumulator Co., Ltd.:—

480 cells, 13-plate, for Dumbarton; 26 cells, 5-plate, for Derby; 55 cells, 17-plate, for Oxford; 110 cells, 25-plate, for Croydon; 54 cells, 9-plate, for Tain, N.B., all "S" type; 54 cells, 23-plate, "C S" type, for Ealing; 54 sections, renewals, for Newcastle; and 108 cells, 7-plate, "L" type, for South Africa.

Calendar.—Messrs. Siemens Bros. & Co., Ltd., are the first in the field, so far as we are aware, with a pocket diary and calendar (Letts) for electrical engineers for 1906. Tabulated information, which will be of interest and value to everyone at some time or other, occupies the first few pages, and some neat half-tone illustrations of Siemens's plant, &c., come next, followed with an ample allowance of space for daily notes. The £1,000 Accident Assurance coupon is not likely to be overlooked.

Book Notices.—*The Electrical Testing Laboratories.*—This is a neat reprint of an article published in the *Electrical World and Engineer*, New York, January 7th, 14th and 21st, 1905, by C. H. Sharp, Ph.D., describing the laboratories named as above, which have been equipped by a company in New York. Judging by the particulars given and the illustrations, the equipment is of the most modern and complete description; ample space has been provided, and apparatus has been installed for carrying out every kind of test that is likely to be required. No fewer than 6,000 lamps can be tested for life simultaneously, each at its own voltage, and storage is provided for 50,000 lamps, besides lock-up storage for over 3,000 lamps. The Matthews integrating photometer is used for arc lamp testing. Altogether the equipment is well worth study by those interested in such matters.

Annalen der Physik.—The last two numbers of the *Annalen* (Band 18, Heft 2, 1905) contain several papers of interest. In No. 12 there is an account by Stark, Retschinsky and Schaposchnikoff, of their investigations in regard to the distribution of potential in the mercury lamp. Their paper begins with a summary of the present state of knowledge concerning the ionisation theory as applied to arc phenomena. Experiments are made with different electrodes and with different gases, and some general conclusions are arrived at as to the relative velocities of the ions in the anodic and cathodic regions of the discharge, respectively, and as to the temperature conditions. Peter Nell contributes an account of his researches upon the diffusion of aqueous solutions through gelatine. Among other results, he finds that gelatine exerts a retarding effect upon diffusion, and diminishes the conductivity of such solutions; diffusion and ionisation in such cases are influenced by the addition of gelatine in *direct* proportion. Ostwald's explanation of the Liesegang ring (E. Liesegang, "Chemische Reaktionen in Gallerten," Düsseldorf, 1898) is not accepted by Nell as sufficient. A paper by J. S. Sachs concerning the influence of the earth in wireless telegraphy indicates that for waves 31 metres in length, the earth's surface acts as a strongly absorbing and weakly reflecting medium. The introduction of a condenser in the circuit to earth is prejudicial to transmission. Care should be taken, especially when transmitting by comparatively short waves, to insulate the apparatus effectively from the earth. Trees in foliage absorb and reflect the waves. If they are between stations they may weaken transmission, but when they are behind the apparatus they may improve matters. The plane of transmission should be perpendicular to the plane of the antennæ. The intensity of a system with two antennæ is three or four times as great as that of a system with only one and a condenser. Wires perpendicular to the antennæ and to the line between stations exert no influence upon transmission; if they lie along the line between stations they improve the working. Wires placed parallel to the antennæ screen the transmission more, in proportion as they are well earthed. For effective transmission such conductors should therefore, if possible, be insulated from the earth. With waves of 30 metres the "integral effect" of transmission diminishes as the square of the distance. The *Annalen* No. 12 also contains a discussion by Aschkinars on the relation between the electrical conductivity of metals and their reflecting power for ultra-red rays, and a paper by R. H. Weber on the measurement of the permeability of steel spheres. No. 13 includes an elaborate paper by Ignatowsky on the reflection of electro-magnetic waves in a wire, another by Voege on the discharge of electricity through gases, and others of theoretical importance.

"Hazell's Annual for 1906." (24th year.) Edited by W. Palmer. London: Hazell, Watson & Viney. 3s. 6d. net.

"Practical Dynamo and Motor Construction." By Alfred W. Marshall. London: Percival Marshall & Co. 1s. net.

"Baku: An Eventful History." By J. D. Henry. London: Archibald Constable & Co. 12s. 6d. net.

"Papers and Reports relating to Minerals and Mining, Comprising Statement by the N.Z. Minister of Mines, Report on the Goldfields, Report on Coal-Mines and State Coal-Mines, 1905." Wellington, N.Z.: By Authority.

"Mica, its Occurrence, Exploitation and Uses." By Fritz Cirkel. First of a series of publications to be issued by the Mines Branch of the Canadian Department of the Interior, on the Economic Minerals of Canada. London: Offices of the High Commissioner for Canada.

"Handbook on British Patents for Inventions; also referring to Colonial and Foreign Patents." London: Day, Davies & Hunt, 322, High Holborn. 6d.

"Report on Progress of Work of the Engineering Standards Committee, from January, 1901, to July, 1905." London: By the Committee. The above is a short account of the work of the Committee from its inception to July 31st last, together with a list of the members serving on the committees, and a list of the publications and templates issued. The number of committees has gradually grown from the original single committee formed by the Institution of Civil Engineers to 35 sectional committees and sub-committees, the whole work being now supported by the five leading technical societies. The Committee is also receiving the support of H.M. Government, and there are serving on the different committees official representatives from most of the technical societies and trade associations of the country.

Smoke Abatement Exhibition.—Among the interesting exhibits shown at the Royal Horticultural Society's Hall, Vincent Square, Westminster, by the Royal Sanitary Institute in conjunction with the Smoke Abatement Society, is that of Messrs. Ed. Bennis & Co., Ltd., Little Hulton, Bolton.

One of their newest things is a fine model of the "Bennis and Miller-Bennett" improved smokeless chain grate stoker. This machine is specially applicable for furnaces of steam boilers refuse

destructors, and like purposes. The top surface of the chain grate remains continuous across the junction of each pair of links, and there is no opening at the end of the links into which ashes or clinker can fall, or an excessive quantity of air gain admission, even at the ends where the chain grate passes over the revolving drums. The importance of this improvement can scarcely be overrated. The fuel is fed over the whole width of the grate, and the depth of the fire regulated by raising or lowering the fire doors by means of a hand-wheel. These doors open outwards as in ordinary hand-firing. An improved arrangement of the fire bars enables the whole of the back end of the furnace to be used as a cooling place for the clinkers. The dumping bar is placed at the back end of the grate, thereby removing it from the intense heat of the furnace and affording extra grate area. It should be mentioned that the patentees claim that a very small percentage of coal is lost between the bars as compared with other chain grates, and this is practically confined to dust. We are informed that excellent results have been obtained with this grate at the Kensington and Notting Hill electricity works, where it may be seen in operation, and orders have already been placed by leading firms, electric light and power stations, &c., with Messrs. Bennis, who are the exclusive manufacturers.

A second exhibit shown by this firm consists of the "Bennis" patent stoker and compressed air furnace, which is shown applied to a Cornish boiler, and is in active operation. The coal is supplied to the fire intermittently in very small quantities, and each time to a different part of the fire; the amount of feed is controlled by a simple adjustable cam on the right-hand side of each stoker. The self-cleaning furnace shown is of the "Bennis" patent compressed air type, by which the supply of air is exactly adjusted to the evaporative requirements of the boiler. The furnace is entirely self-cleaning, and is so arranged that the wearing parts are practically "everlasting."

The third exhibit shown on this stand (No. 21) is the well-known "Darling" calorimeter, which is claimed to be extremely simple, giving very accurate results.

Whist Drive.—The staff of Messrs. Veritys, Manchester, together with friends, had a very enjoyable evening on Saturday last, when a whist drive was held at the Exeter Restaurant, Manchester. The drive consisted of two series of games with an interval for refreshments and the greatest interest was taken in the various scores, excitement running high. The evening was brought to a close somewhere about 11 p.m., after prizes had been given and a few short speeches made. We hear that it is likely that other drives will follow at an early date. The chair was taken by Mr. W. M. Landon, in the absence of Mr. M. B. Cotterell, director.

Annual Dinner.—On Saturday last the members of the Robertson Private Fire Brigade held their second annual dinner at the Brook Green Hotel. Mr. Wilson, the works manager, was in the chair, and Mr. Driver, the assistant manager and superintendent of the fire brigade, occupied the vice-chair. After dinner, the evening's entertainment took the form of a smoking concert, during which several toasts were proposed. Mr. Wilson, speaking on behalf of the firm, said that the members of the fire brigade should be proud of the position which they held, as they were recognised by the firm to be the most trusted of their employés, as, in the event of any outbreak of fire occurring, the primary responsibility of checking the fire rested with these men. At the same time, he reminded them that their duty was not to supersede the London Fire Brigade, but to render first aid until their arrival. Remarking on their success this year at the London Private Fire Brigade Competition, he thought that they missed carrying off the championship cup through their over-confidence, although they were to be congratulated on taking away one first prize and two second prizes. Mr. Driver replied on behalf of the members of the fire brigade, regretting that they had not succeeded in carrying off the cup this year, but they would make sure of doing so next year. Mr. Rushforth, of Merryweather's, chairman of the London Private Fire Brigades Association, replied on behalf of the visitors.

Brush Contracts.—The following contracts have been booked by the Brush Electrical Engineering Co., Ltd.:—

Manchester Corporation.—20 four-wheel tramcar trucks.
New South Wales Government (Traction Department).—Four type AA. trucks.
New Plymouth (N.Z.).—75-kw. three-phase alternate-current generator.

E.C.C. Hospital Fund.—The employés of the Electric Construction Co., Ltd., Wolverhampton, have, during the year, contributed £155 10s. 4d. to the local hospitals.

Catalogues and Lists.—Messrs. Elliott Bros., Lewisham, S.E.—Pamphlet describing and illustrating their new network ohmmeter (Groves's patent).

Worthington Pump Co., Ltd., 153, Queen Victoria Street, E.C.—Leaflet No. 107. A well-illustrated 12 pp. pamphlet fully detailing with diagrams and tables of sizes and code words, their exhaust steam oil separators; also showing steam and electric-driven oil pumps and exhaust heads.

Messrs. R. W. Blackwell & Co., Ltd., City Road, E.C.—Three new lists. Section 14 for addition to their recently-issued catalogue No. 59 relating to circuit-breakers. Also a new catalogue, No. 81, entitled "Electric Transmission Lines: High and Low Tension," in which are given prices and particulars and useful line diagrams of the firm's standard porcelain and brownware insulators, pins, brackets, straps, &c., for overhead transmission work. Suitable tools for use on electric power lines are further particularised. Messrs. Blackwell are specialists in overhead transmission, and are paying particular attention to porcelain and brownware insulators, of which, we understand, they hold large stocks. The catalogue should prove interesting to engineers connected with the work of modern electrical power distribution. Illustrated leaflet describing their improved air-gap pattern section insulator, which is fitted with "Aetna" insulation. This is a new type recently taken up by the firm.

Mr. James Ferguson, Pollokshaws, Glasgow.—Illustrated circular describing the Glasgow arc lamp starter, of which we gave full particulars last week.

Messrs. Ferranti, Ltd., Hollinwood.—Catalogue No. 53, giving prices of single-pole, double-throw, quick-break knife switches.

Sturtevant Engineering Co., Ltd., London, E.C.—New Sectional Catalogue No. 43, illustrating and describing the Sturtevant "steel plate" fans. These fans have been expressly designed for handling large volumes of air with the least expenditure of power, and are particularly adapted for such purposes as ventilating, drying, boiler draught, &c. The true test of a fan's efficiency is not simply its volumetric capacity against no resistance, but its volumetric capacity per horse-power when working against a specified resistance. A small fan run at high speed, although possibly cheaper in first cost, may easily require 50 per cent. more power than a larger fan run at a slower speed would take to do the same work. This 48 pp. catalogue, which is very fully illustrated, is intended for insertion in the special expanding cover circulated by the company a short time ago.

The Lahmeyer Electrical Co., Ltd., London,—New card list giving prices of the company's new type of single-phase motors, slip-ring and squirrel-cage, 50 cycles. The machines are all fitted with patent ball bearings.

Brockie-Pell Arc Lamps.—Messrs. Duncan Watson and Co. have placed with the Brockie-Pell Arc Lamp, Ltd., an order for 300 of their new single enclosed arc lamps to be used for lighting one of the largest drapery establishments in the West End.

LIGHTING AND POWER NOTES.

Accrington.—The T.C. has by a large majority rejected a proposal that the Corporation electricity department should do its own wiring, instead of placing the work out to contract.

Australia.—Balmain (N.S.W.).—The work of substituting electricity for gas in the lighting of the streets is shortly to be commenced. The offer of Messrs. Kenway & Co. to light the borough with electricity, to provide motive power, and to remove and destroy all garbage, has been approved by the Council, and an agreement entered into.

Birmingham.—The City Council has approved of the reduction in the scale of charges for energy, recommended by the Electricity Committee, the same to take effect as from January 1st next.

Boston.—The T.C. has rejected a recommendation from the Lighting Committee that the Council should proceed to carry out the E.L. order, an amendment that the Committee should make the best terms possible with any company seeking to obtain a prov. order being carried by 14 votes to 6.

Brandon.—The U.D.C. has decided not to consent to the application for a prov. order for E.L. being made by the County of Durham Electric Power Distribution Co., but will not go to any expense in opposing it.

Bridlington.—On the 6th inst. an accident occurred at the municipal electricity works, the town being in darkness during part of the evening. A Yorkshire paper states that a fire broke out behind the main switchboard, the back of which was wrecked, and that the damage done may amount to over £100.

Brighton.—An inquiry by the L.G.B. was opened at the Town Hall on the 12th inst., respecting an application by the T.C. to borrow £38,500 for the purposes of the electric lighting undertaking, and £5,909 for a site and buildings for a new sub-station. The inquiry was continued on the 13th.

Canada.—Montreal.—The lighting contract entered into with the Montreal Light, Heat, and Power Co. in 1901, called for a gradual reduction in the price of street lighting. From January 1st, 1906, the price for lighting the street lamps will be $60 a year, while for the current year the average price is $89·82. At the present time Montreal has 1,455 arc lamps, 90 65-c.p. lamps, 310 32-c.p. lamps, and 380 gas jets.

Clacton-on-Sea.—The U.D.C. has accepted tenders, amounting to £11,472, for carrying out a scheme for lighting the Front and other principal thoroughfares by electricity.

Continental Notes.—Germany.—An electricity works is to be erected at Lobsen (Posen).

Italy.—It is proposed to put down a hydro-electric power plant on the River Aso, at Carassai, Ascoli, and application for power to do so has been made.

Crediton.—In regard to the resolution approving of the proposal of the Crediton Gas Co. to supply the town with electric light, the U.D.C. has resolved to oppose the application of the gas company, and to support Messrs. Christy & Co.'s application.

Cannock and Hednesford.—Last week a report by the E.L. Committee was submitted to the Council on an experimental scheme, involving an expenditure of £3,000, by which it was proposed to light a compulsory area in the centre of Cannock. A petition was presented from the Hednesford Tradesmen's Association protesting against the scheme. A similar petition was signed by a large number of Cannock ratepayers. After some explanation of the scheme had been given, however, the report was adopted.

Darlington.—It was stated at a meeting of the T.C. on December 6th, that the net loss on the electricity and tramway undertakings for the past year amounted to £1,400. This, however, did not include any allowance for depreciation.

Dublin.—A L.G.B. inquiry was held on 5th inst. into an application made by the Corporation for sanction to a loan of £100,000 for extending the electric lighting works.

The inquiry was resumed on the 7th inst., when Mr. Ruddle explained that it is necessary to install new boilers at the Pigeon House station, and to lay new mains. The engineer, we gather from a local report, stated that the Corporation is required by the Home Office to improve the safety of the switchgear. It is necessary and more economical to make the proposed alterations in the sub-stations in the old area, in view of the proposal to make the mains suitable for three-phase current. A question elicited the fact that if there was time the existing boilers, which are in various conditions, could be improved in efficiency. They were in the highest state of efficiency when put in, but require overhauling. The inquiry was further adjourned.

Dumfries. — The India-Rubber, Gutta-Percha and Telegraph Works Co. is to take over the Council's prov. order, paying £700 for initial outlay, a rent of £100 yearly for the site and £30 to cover the cost of inspection. The Council is to have the option of purchasing the works on payment of the capital expenditure and a premium of 25 per cent.

Eastbourne.—The T.C. has decided to make a reduction of 1d. per unit, in the present price of 5½d. for electricity supplied to private arc lamps used outside consumers' premises.

Erith.—The U.D.C. has decided to reduce the price of energy for power and heating as follows, as from March 31st next:—Up to 1,500 units per month, 2d. per unit; from 1,500 to 3,000, 1¾d.; beyond, 1½d.

Gomersal.—The U.D.C. on December 7th considered an application from the Electrical Distribution Co., asking for the Council's consent to the application for a prov. order for E.L. The company offered to fix the maximum charge for energy at 6d. per unit instead of at 8d., to pay the Council's reasonable costs in the matter, and to provide a supply at the earliest date. The Council decided to take no action either way in the matter.

Halesowen.—The U.D.C. has received a letter from the B. of T. in reference to the E.L. order which was obtained in 1899, and had since been extended. The Council replied asking the Board not to revoke the order, and stating that it is negotiating with the Empire E.L. and P. Co.

Heston-Isleworth.—A L.G.B. inquiry was held at Hounslow on 8th inst. into the application of the U.D.C. for sanction to a loan of £11,500 for E.L. extensions.

Higham Ferrers.—The T.C. has decided to confer with the County of Northampton Electric Power and Traction Co., who are applying for a prov. order for E.L., respecting terms for the supply of energy, &c.

Hipperholme.—The E.L. Committee of the U.D.C. has decided to circularise the ratepayers with the object of ascertaining the number of prospective users of energy.

Hythe and Sandgate (Kent).—The Folkestone E.L. Co. is promoting a Bill, as the result of the law suit, Sudbury Corporation *v.* The Empire E.L. and Power Co., with the object of making the transfer of the Hythe and Sandgate E.L. Orders legal; these Orders, which have been taken over by the company, not containing any clause authorising the transfer.

India.—Calcutta.—The Calcutta Port Commissioners are making special arrangement for lighting the new landing stage at Chandpal Ghat. Electric lights are to be installed on the pontoons and bridges, &c., in the buildings. The Commissioners are erecting their own generating plant at the jetties, but it will not be ready before April. In the meantime energy is to be purchased from the E.L. and Power Co.

Inverness.—The North of Scotland Electric Light and Power Co. opened an electrical exhibition in the Music Hall on 7th inst. The exhibition will last a fortnight.

Larne.—The U.D.C. has received revised tenders for the lighting of the town. The E.L. tender was £450 per annum for a term of three years, and the Larne Gas Co. tendered at £300 for winter lighting and 12s. 6d. per lamp for summer lighting, exclusive of the provision of mantles. The Council has accepted the tender of the E.L. Co.

Llanelly.—With a view to lighting some of the streets by electricity early next year, the U.D.C. proposes to give the gas company notice to terminate its agreement.

London.—Hackney.—The boiler plant at the electricity works is to be equipped with the chain-grate air-seal.

The costs of opposing the electric power Bills in Parliament last session, amounting to £1,845, are to be charged to the electric lighting reserve fund.

Battersea.—The Lighting Committee of the B.C. has decided that the charges for meter rents shall be altered as follows:—If any consumer's quarterly account amounts to less than 12s., a meter rent of 3s. be charged; exceeding 12s., but be less than 15s., such sum shall be charged for rent as will bring the total up to 15s., no meter rent to be charged to consumers whose quarterly accounts exceed 15s. If more than one meter is fixed on a consumer's premises, the above conditions shall apply separately in respect of each meter. In reference to the agreement entered into with the County of London Electric Supply Co. relative to the supply of energy in areas transferred under the provisions of the London E.L. Areas Act, 1904, the amount to be paid to the company is £595.

L.C.C.—The question of some of the London Supply companies providing testing stations for the Council's inspectors of electrical energy, was brought up by the Highways Committee. It was suggested that a notice should be served on the County of London Co. to provide such stations for the convenience of the L.C.C. to test the supply.

The Bill which the Council is promoting for powers to supply electricity in bulk, and which has been framed on the basis of the Council co-operating with existing local authorities, will be supported by Sir W. H. Preece, Mr. Robt. Hammond and Mr. John F. C. Snell, as expert witnesses. The scheme contemplates using the temporary surplus of energy from the Council's Greenwich station during the early stages, as the 34,000 kw. of plant to be there installed, will not be all required for tramway purposes for some five or six years. In the meantime another generating station of 80,000-kw. capacity is proposed, on the riverside at Battersea, near the Grosvenor Road railway bridge. The site comprises 15 acres, and belongs to the Metropolitan Water Board; its estimated cost is £120,000, and any portion of it not required for bulk supply purposes will be utilised for the tramways. The station will be put up in sections, and two of the latter (40,000 kw.) are proposed as the first installment. While the temporary supply is being given for bulk purposes from Greenwich, it is proposed to charge the undertaking with the average cost, including a proper proportion of the capital charges, and, as soon as the Battersea station is running, it will also be used for tramway purposes. The majority of the existing and proposed tramways sub-stations will be available as bulk supply centres, which it is proposed shall be linked up to the Greenwich station by the bulk supply undertaking. It is pointed out that, in comparison with other schemes, this one restricts the right of breaking up streets to the public authority.

The provisions of the draft Bill define the area of supply as 387 sq. miles, including 117 in the County of London and 270 sq. miles of the surrounding area. Powers are sought to enable the Council to supply (*a*) to authorised distributors, (*b*) to railways, tramways, canals, docks, waterworks, and similar undertakings for use within, and partly within and without, the area. The Council is not to supply for use wholly within any area where an authorised concern is giving a general supply, without the latter's consent. Other clauses relate to the erection of a generating station, the coworking with the tramways undertaking, revision of prices, and sundry financial matters. The capital expenditure is estimated at 2½ millions, spread over 7 years to 1913. The amounts required in the first three years are estimated at (1907) £355,000, (1908) £545,000, and (1909) £449,000. It is suggested that the Council's bulk undertaking will reduce the borrowings (from the L.C.C.) of the Borough Councils for their undertakings, but that the extra cost of transmission for the large scheme would to some extent neutralise any saving thus effected; the important saving would be in working expenses.

Islington.—The Lighting Committee has proposed to the T.C. an expenditure of £21,011 for the E.L. extensions. It was proposed that the arc lighting should be substituted for gas lighting in about 15 miles of streets. The number of new arcs would be about 245, and they would displace 714 incandescent gas lamps. In view, however, of the present discussion on London E.L. and power supply, the B.C. has declined to sanction any further large capital expenditure.

St. Pancras.—The B.C., in seeking powers in the next session of Parliament to extend its electricity undertaking, desires exemption in respect of all lands used in connection with electricity and dust destructor works, from "all indictments, actions and other proceedings for nuisances." Would the B.C. agree to a private company's Bill containing such a clause?

Hampstead.—To provide for the increased load expected next winter, the B.C. has resolved that the output shall be increased by altering two of the Ferranti sets to run in parallel with the other plant, at a cost of £600 per set, the work to be executed by Messrs. Musgrave & Sons, of Bolton. The cost is to be paid out of the reserve fund or revenue. The price for energy for motors is to be reduced from 2d. to 1d. per unit, with a minimum charge of £1 per quarter per kw. installed, or, at the option of the consumer, to 1½d. per unit without a minimum charge. It was also decided to reduce the charge for current for heating from 2d. to 1½d. per unit.

Macclesfield.—The B. of T. has approved of the system of electrical supply submitted by the T.C., and the latter on December 6th, decided to place before the B. of T. plans of the E.L. station. A loan of £250, to cover the cost of obtaining an E.L. Order, 1901, has been applied for.

Messrs. Foote & Milne, Ltd., have intimated that they are applying for a prov. order for E.L.

Middlesbrough.—The E.L. Committee of the T.C. has refused the application of the Cleveland and South Durham Electric Power Supply Co. for permission to supply energy for power to three firms in the borough, on the ground that the Corporation was already supplying power on reasonable terms.

Pontefract.—The T.C. on December 6th decided by 13 votes to 7 to oppose the application of the Electrical Distribution of Yorkshire, Ltd., for E.L. powers, owing to the West Yorkshire Electric Supply Co. already possessing powers to supply in bulk.

Rhymney.—A syndicate which had given notice of intention to apply to the B. of T. for a prov. order for E.L., has informed the U.D.C. that it has abandoned the scheme for the coming session of Parliament.

Salford.—Mr. C. D. Taite, the Salford Corporation electrical engineer, stated at the annual staff dinner on Saturday last, that in a year the Salford electricity undertaking had risen from fifth to second place among similar municipal undertakings of the country. The coal cost was the lowest in the country, *i.e.*, ·194d. per unit; the works costs amounted to ·486d.; and the total costs, including interest and sinking fund, was 1·544d. per unit. The number of units sold during the past year amounted to 9,002,310. A maximum load of 3,600 KW. was recorded. The load factor worked out at 28·5. The H.P. of private motors connected at March last amounted to 2,817.

South Africa.—SIMON'S TOWN.—The ratepayers recently held a meeting to consider the town lighting question. At present it is carried out by 61 oil lamps, at a cost of £230 per annum. The Pioneer Gas Lighting Co. offers to erect 75 lamps and light the town at a cost of £9 each per annum. The consulting electrical engineer of Cape Town has also introduced the question of electric lighting, and the matter has been postponed to consider his suggestions.

CAPE TOWN.—The lighting of Hall's American Hippodrome has been carried out by Messrs. Green & Trevett, of Cape Town, who have installed 28 arcs, 9 200-C.P. and 179 16-C.P. incandescent lamps. The whole of the wiring is carried out by overhead wires run on iron poles, the Hippodrome being a temporary erection only.

EMBABAAN (SWAZILAND). — A new electric hoist and pumping gear was formally started yesterday at the Forbes Main Reef Mine, by Mrs. Enraght Moony, the wife of the resident engineer. The machinery is intended to facilitate the work of sinking the new incline shaft on the Reef.

South Shields.—The number of units sold during the past quarter was 138,086 against 137,250 for the corresponding period last year, but there is a reduction in revenue of £236, the average price obtained being 4·22d. as compared with 4·71d. per unit in the same period of 1904.

Southwick-on-Wear.—The U.D.C. is considering the question of lighting the main thoroughfares by electricity, and it has been proposed that the County of Durham Electrical Power Distribution Co. should erect lamps and supply energy.

Standish.—The B. of T. has informed the U.D.C. that consideration of the question of revoking the E.L. order has been deferred for a year.

Taunton.—On December 6th a L.G.B. inquiry was held into the Corporation's application for a loan of £4,844 for E.L. purposes. It was explained by the town clerk during the course of the inquiry that as a result of the 11 years' working of the undertaking by the Corporation, £1,270 had been repaid to the rates, in respect of £1,775 contributed by the rates during the first four years of working. Continuing, a Somerset paper gives the clerk credit for having stated that £10,904 was repaid by sinking fund "recognised by the board as in lieu of depreciation"; £2,048 had been set aside to reserve and meter funds. A local councillor endeavoured to point out to the Inspector the desirability of providing for depreciation, but apparently his colleagues did not hold the same views.

Tiverton.—The T.C. has decided to present to the L.G.B. its objections to the cancelling of its E.L. order, and its objections to granting an order to the National Provincial Electricity Co.

Torquay.—The T.C. has decided to apply to the L.G.B. for £800 for extending the distributing mains; £1,000 for extension of condensing plant; and £260 for the installation of de-oiling plant.

Tredegar.—The 1901 E.L. order has been revoked by the B. of T.

Tunbridge Wells.—The T.C. has decided to adopt an optional double tariff for the supply of energy, the charges being 2d. per unit for energy supplied between midnight and dark, and 6d. per unit at other times, with rent for an additional meter.

Uxbridge.—The Steel Barrel Co., Ltd., officially opened its new works at Uxbridge on the 6th inst. An interesting feature in connection with the company's new plant is the adoption of electricity for welding purposes, under which process the company can turn out 200 steel barrels a day.

West Ham.—The engineer, Mr. A. H. Seabrook, has recommended the installation of four more chain-grate stokers and a total of eight by November next. The Council has adopted the recommendation. In regard to the hiring of motors, consumers pay a fixed rental per annum, based on the horse-power (and not the price of the motor) plus a flat rate of 2d. per unit for all energy used. This price, being in some cases prohibitive, and considerably higher than the rate of charge for power supply to other consumers, alterations have been made so that in future the charges are to be 15 per cent. per annum on the cost of the motor, and a supply of energy at the ordinary power rate.

Westhoughton.—The U.D.C. has approved of an agreement with the Lancashire Electric Power Co. for the establishment of an electricity supply. The Council is to provide £5,000, and will have the option of purchase at the end of 7, 10 and 14 years; for public lighting, energy is to be sold at 2½d. per unit.

Whitefield.—The U.D.C. is asking Bury, Salford, Radcliffe, and the Lancashire Electric Power Co. for terms for a supply of electricity to the town.

Wolverhampton.—A sum of £700 is about to be expended on the installation of further E.L. cables.

TRAMWAY AND RAILWAY NOTES.

Ayr.—The T.C. has decided to appoint a Committee to report as to the advisability of extending the tramway system through Hawkhill to Whitletts.

Birkenhead.—The Watch Committee of Birkenhead recently licensed four motor-omnibuses, which have been provided by the Mersey Railway Co., to be run as feeders to the railway, which includes the Mersey Tunnel service between Liverpool and Birkenhead. The action of the Watch Committee gave rise to a long and warm discussion at the monthly meeting of the Birkenhead T.C. last week, the opposition being based on the assumed competition of the 'buses with the electric tramways, which are owned by the Corporation, in Birkenhead, which competition, it was affirmed, might mean the fixing of a 1d. rate on the town. The action of the Watch Committee was ultimately sustained. The four motor-'buses commenced to run on Saturday; they have cost about £900 each, and will run between the central station and the higher parts of Birkenhead to the west and south-west of the town, in districts which are served by the electric tramways. The tramcars run to the ferry, and so feed the boat service across the river. The aim of the railway company is to secure much of the traffic which has hitherto been done by the ferry steamers.

Brierley Hill.—At a recent conference with the Birmingham and Midland Tramways Joint Committee, in which one of the things asked for by the U.D.C. was a circular route between Brierley Hill and Kingswinford, Mr. Lycett, managing director of the company, said the company appreciated the advantage of a circular route when the line was laid down, and powers were then applied for, but the attitude of the Council being then one of opposition, the company gave up the project. The company were now powerless to do anything, as the Dudley Corporation was determined to take over the tramways in that borough. With regard to ½d. stages, the experience of the company was against these being given. As regarded overlapping stages, the company might be able to meet the wishes of the deputation.

Cardiff.—Last week an action was heard at Cardiff County Court in respect of a claim against the Corporation on account of injuries sustained by a child named E. M. Coakley, who was knocked down by an electric car in September. The jury returned a verdict for £50, the amount claimed by the plaintiff.

Clydebank. — Following a communication from the B. of T., the T.C. has decided to oppose any suggestion on the part of the Glasgow Tramways Committee for a 16-mile maximum speed of the cars on Dumbarton Road, demanding that in all parts of the burgh the maximum speed should not exceed 12 miles an hour.

Continental Notes.—ITALY.—The Public Works Department have given favourable consideration to the project for a funicular railway, worked electrically, from the seashore near Capri to Anacapri. The length of the inclined plane is 660 metres, and the difference in levels 139·3 metres; the maximum gradient is 48 per cent.

SWITZERLAND.—The Swiss Commissioners appointed to examine existing electric railways with the view of adopting electric traction in the Simplon tunnel have now returned. At a recent interview one of the members informed our correspondent that the commission was very favourably disposed to the adoption of the three-phase traction, as exemplified on the Valtellina road in Northern Italy. It appears that Messrs. Ganz & Co. and the Brown, Boveri firm could offer very favourable deliveries of three-phase locomotives and material, and as the inauguration of the Simplon will most probably take place in May or June next, the question of deliveries is bound to affect the decision of the Commission. It was further stated that if good offers of direct current material were forthcoming they would receive favourable consideration, the direct current system being in every way suitable to the proposed installation. It is believed that the larger German firms are preparing a very tempting offer on these lines. It will be seen that this statement differs in some respects from the particulars given in our issue of the 1st inst.

A law is in preparation, to be placed before the Swiss Federal Council, with the objecting of forbidding the sale to districts outside of Swiss territory, of electrical energy generated from the mountain falls and torrents. It is considered that the principle

involved in this case was raised because of a recent discussion in the Council wherein it was stated that all the available sources of energy would be required to supply the Swiss railway system, whenever the lines were electrified on a large scale. The time is not considered to be very far distant when these demands will be made, and the present is a measure of precaution to safeguard Swiss interests in regard to contracts for the supply of energy abroad.

France.—There have been running on Paris streets for the past few months, a number of motor-omnibuses of various types and of the principal French makes, but the 'buses have been loaded with sandbags in lieu of passengers, and the tests have been very cautiously undertaken by the Compagnie Générale des Omnibus, which has at length stated its intention of commencing in the Spring of 1906, a number of lines of motor-'buses. Among the 'buses to be represented will be those with engines operated by petroleum, alcohol and (Serpollet) steam. There will also be a line of 'buses supplied by the Kriéger firm, driven by their petrol-electric combination. The engine is flexibly coupled to a 24 or 30-kw. generator, from which power is transmitted to the two 12-h.p. motors geared to the rear wheels of the 'bus. Owing to the success attending this type of 'bus at the recent trials on French roads, it is expected that these petrol-electric machines will give a good showing.

The Cie. des Chemins de fer du Sud has obtained a concession for the installation of electric tramways at Grasse. It is expected that the necessary official authorisation will shortly be given to put the work in hand, and the concession-holders are anxious to commence service within a year after this authorisation.

The P.L.M. Railway Co. are actively continuing the scheme for the electrification of their Cannes-Vintimille line, and in view of the successful tests made on the rectifier designed by their chief electrical engineer, will shortly be looking round for constructors. It is thought that the Westinghouse Co., who have large works at Havre, may undertake the construction of this apparatus, and, perhaps, also the traction material.

Norway.—According to the *Elektroteknisk Tidsskrift* (Christiania), a new electric railway is to be constructed between Christiania and Sandviken. The railway is to be of 1·435 metres gauge, the central lines of the tracks being 4 metres distant and the rails 29·76 kg. in weight per metre. The maximum gradient is 1 in 50, and the minimum radius of curves 200 metres. Motor-cars having a speed of 60 kilometres and more per hour are to be used. The journey from Christiania to Sandviken is to be completed in 21½ minutes, corresponding to an average speed of 37½ kilometres per hour, inclusive of stoppages. One hundred and twelve trains are to be run each day. Electrical energy will be supplied from a special power station near Hovik or Lysaker, or from the municipal electrical works. The cost of construction is estimated at 1,770,065 kronor, inclusive of the cost of land purchase, rolling stock, line, and electrical plant.

Sweden.—With reference to the proposed electrification of the Swedish State Railway system, the *Elektroteknisk Tidsskrift* reports that experiments have for some time been carried out on the Värta railway, with good results. In June last the first electric locomotive (American make) of relatively small size was introduced. Another locomotive from Berlin was introduced in September, in addition to several motor-cars manufactured at the Swedish State Railway workshops in Tomteboda. As soon as the electric railway to Järfva has been completed and connected to the capital, electric trains will be used. The electric conductors and track have been completed as far as Värta. The work is being continued on the Tomteboda-Järfva section, and next year the railway is to be continued as far as Stockholm Central Station.

Croydon.—On Monday the Borough Council had before it a recommendation of the Tramways Committee that the offer of the British Election Traction Co., Ltd., for a fresh lease of the system should not be accepted. The company offered to increase the yearly payment upon the capital expended by the Corporation from 6½ to 7 per cent., and to increase the amount contributed towards road repairs. These two items would represent an increase of about £3,000 per annum on what has hitherto been paid. Further, the company offered to give the Corporation 25 per cent. of the net profits, in addition to the 7 per cent. already spoken of, and to allow the books and accounts to be open for inspection for ascertaining the amount due. The proposed new lease was for 21 years, determinable at seven or fourteen years on six months' notice on either side. In the discussion it transpired that the offer was tantamount to an extra contribution of about £4,000 a year. On the other hand, the lease proposed a continuance of the supply by the Corporation to the company of electrical energy at 2d. per unit.

The Council unanimously agreed to refuse the company's offer; but it was fully understood that this decision did not imply that the Corporation had accepted the principle of taking over the entire control of the tramways. At present it is very strongly inclined to do so, but a definite vote is in abeyance in anticipation of a further offer from the company. The Tramways Committee's report also contained a recommendation that proceedings should be taken against the B.E.T. Co. for the recovery of £3,000 in connection with the temporary leasing of the short length of line just completed at South Norwood, over which the dispute has been so prolonged. The completed line has been unused, because the company refused to accept the lease, an act which would at once involve them in this sum of £3,000 towards bridge improvements, and this with the knowledge that their tenure of the line for more than six months is very doubtful. But on Monday evening, when the Council was about to discuss the life or death of the company as far as Croydon was concerned, a letter arrived during the proceedings from Mr. Charles H. Dade, secretary, which stated that in order to avoid any undesirable friction with the Corporation, and consequent inconvenience to the public, the B.E.T. were now prepared to accept the lease of Tramway No. 20, and to work the line thereunder at the earliest possible date.

Dundee.—The Dundee, Broughty and Monifieth tramway will be in operation this week. The contracting company is liable to the penalty of £100 per week from the 5th inst., and work is being pushed forward rapidly. A temporary iron chimney has been erected at the generating station to save time, but a brick one will be substituted later.

East Ham.—At the meeting of the T.C. on Tuesday a letter was received from the North Metropolitan Tramways Co. stating that they were prepared to accept £25,000 for their lines and depôt in the Romford Road, and to waive the question of the purchase of the cars and horses, provided the Council would undertake to complete the purchase by the 31st prox. It was resolved that an offer of a certain sum be made to the company for the undertaking.

Folkestone, Hythe and New Romney.—The New Romney T.C. has requested the engineer of the proposed electric tramway scheme from Sandgate and Hythe to the town, to interview the Corporation and explain the scheme. The promoters, if they obtain the powers sought for, will take over the horse tramway from Sandgate to Hythe, belonging to the South-Eastern and Chatham and Dover Railway Co., who will support the Bill.

Hythe T.C. on December 8th had an interview with Mr. Stephen Sellon, the promoter of an electric tramway scheme from Folkestone to Hythe, and that gentleman offered for the Council's consent alone to give it £1,500, and another £1,000 if the Bill passed. He also undertook to pay a penalty of £1,000 if the construction of the work was not commenced within six months after the passing of the Bill, and added that in two years he would complete the whole line from Folkestone to Romney. Mr. Cownie, of the National Electric Construction Co., also attended, and, in reply to questions, said that no one could legally buy the Council's consent. The Council, before coming to any decision, decided to take the Parliamentary Agent's opinion on the point as to whether the Council could accept the £1,500 offered by Mr. Sellon for the Council's consent.

Halesowen.—The U.D.C. has come to terms with the Empire Electric Lighting Co. respecting the transfer of the order obtained by the Council for the construction of light railways and the provision of electricity in the district. The company has agreed to apply for a prov. order amending the orders obtained by the Council, also for sanction to construct additional light railways, and to repay to the Council the money spent in securing orders.

Hyde and Stockport.—A scheme to enable the Stockport Corporation to take over the whole of the electric car service between Hyde and Stockport is under consideration. For some time past the Oldham, Ashton and Hyde Tramways Co. have run cars through Hyde to Stockport, but the company intimated recently that the arrangement had resulted in a loss to them. The Highways Committee at Hyde has now invited the Stockport Corporation to provide a 15-minutes' service of cars between the two towns for the six years commencing January 1st, 1906.

Leeds.—A motor-omnibus service will shortly be established in the suburbs of Leeds in connection with the electric tramways. One 'bus, of 30 h.p., with accommodation for 34 passengers, has arrived and is undergoing official trials before turning it out for public use. It is proposed to put one 'bus on the Headingley, Launswood and Adel route and another to ply between the tramway terminus at Lower Wortley and Farnley.

The popularity of the covered-top tramcars in Leeds has induced the Corporation to order covers for another 25 cars. Within a fortnight the work will be completed at the Corporation's depôt in Kirkstall Road. The new covers will be a great improvement on those in existence, in regard to both space and ventilation, whilst a simpler method of raising and lowering the windows will be adopted.

London.—The L.C.C. has resolved to approve the Tramways and Improvements Bill, 1906, relating to certain lines promoted in previous sessions and to the following new tramways:—(1) From the "Plough," Clapham, across Clapham Common and *viâ* Clapham Common north side and Cedars Road, to Lavender Hill tramways; (2) from Seven Sisters Road, *viâ* Amhurst Park, to Clapton Common; (3) from Aldgate, *viâ* the Tower Bridge northern approach, to a point near the Tower Bridge; (4) from the Lea Bridge Road terminus, *viâ* Lea Bridge Road, to Lower Clapton Road; (5) from Tooting Broadway, *viâ* Mitcham Road, to the county boundary near Tooting Junction Railway Station; (6) from High Street, Streatham, *viâ* Streatham High Road, to the county boundary at Norbury, with down line *viâ* Gleneldon Road, Bournevale Road and Stanthorpe Road; (7) from near the Marble Arch, *viâ* Edgware Road, Maida Vale, and High Road, Kilburn, to the county boundary at Cricklewood; (8) junction lines between the tramways in East India Dock Road and Upper Clapton Common, and the proposed car-sheds at Poplar and Stamford Hill respectively; (9) further diversion, *viâ* Shardeloes Road, instead of along Malpas Road of the authorised tramways from Lewisham High Road to Forest Hill; (10) loop lines along Curtain Road and Harwar Street respectively, as alternative routes to single line sections of existing tramways in Old Street and Kingsland Road. The total length of the proposed tramways included in the Bill is 13 miles of double track and 1½ miles of single line.

The Highways Committee recently presented a report in relation to the reconstruction of the first group of the northern tramways at an estimated expenditure of £789,000. It was calculated that the

cost per mile of single track would amount to £31,883. After discussion, a recommendation to proceed with the work was adopted.

Metropolitan District Railway.—Many of the "Cross-London" fares between this company's stations and the Metropolitan Co.'s "Inner Circle" stations have been reduced to 4d. first-class and 2d. third-class for the single fare. Return fares are also greatly reduced.

Millerston, N.B.—The Tramways Committee of the Glasgow T.C. has under consideration a proposal to establish a motor-'bus service between the terminus at Cumbernauld Road and Millerston.

Newcastle-on-Tyne.—The Corporation Tramways Committee has under consideration a scheme for the extension of the tramways in the Heaton district, a very populous neighbourhood within the city boundary.

South Lancashire.—We learn that the South Lancashire Electrical Tramways Co., which has been reorganised, is about to lay lines from Hindley, through Hart Common and Westhoughton to Deane, where they will join the Bolton Corporation's tramways. The lines will also be continued from Four Lane Ends through Walkden to Swinton, effecting a junction with the Salford Corporation's system; also from Boothstown through Worsley to Winton, where the Salford lines will be reached again. The South Lancs. Co. will have nearly 100 miles of tramways, and will tap dozens of towns and industrial villages.

Standish.—The U.D.C. has received notice that the Preston and Horwich Tramways Co. intend applying for powers to construct electric tramways in the town.

Swindon.—The T.C. has received from the B. of T. sanction to borrow £2,550 for tramway purposes.

West Ham.—The whole of the track work in connection with the tramway junction at Barking, Beckton and Hermit Roads has been completed and opened for traffic. The Leyton U.D.C. has decided to proceed with the acquisition of properties required in connection with the new tramway scheme, and the West Ham Council has decided to proceed with the construction of its part of the line concurrent with the work in Leyton.

Wood Green.—On Wednesday last week the Turnpike Lane, Priory Road and Alexandra Palace route of the Metropolitan Electric Tramways was opened. Single-deck bogie-cars have been used, on account of the low bridges on the route. The first car was started by Sir Francis Cory-Wright, chairman of the County Council Light Railways Committee.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—The Federal Senate has ratified the agreement concluded by the Commonwealth Government on June 8th, 1903, with the Eastern Extension Co., conferring on the latter the right for a term of years to have special wires and to open offices apart from the Government telegraph stations, and bestowing certain other advantages.

Brighton.—In again refusing permission to the National Telephone Co. to place its wires underground—work which, as it was pointed out, would necessitate the expenditure of £8,000 on unskilled labour, and thus solve the "unemployed" problem in Brighton for this winter—a committee of the T.C. expressed regret that the company should make the necessities of the unemployed an excuse for forwarding its own interests. We should like to know what the unemployed have to say to this. It is perfectly certain that if there had been no municipal telephone system in Brighton the permission would have had to be given; thus the unemployed are called upon to contribute £8,000 to the support of this municipal enterprise for the benefit of the small minority of the ratepayers who use the telephone.

Ceylon.—It is reported that temporary arrangements have been made to enable the Colombo telephone service to be resumed, whilst the reconstruction of the Exchange and the erection of the new poles are carried out.

France.—The postal authorities have decided to establish three new wireless telegraph stations, probably at Bizerta, Port Vendres, and Cherbourg. Like the two already existing at Porquerolles and Ushant, they will only be experimental. The results obtained up to now have been discouraging, and the authorities require to be satisfied as to the value of the system before giving it a permanent extension.

Italy.—The nationalisation of the Italian telephone service now seems about to be taken in hand. At the present time only the trunk lines are in the possession of the Government, while the local telephone networks belong to various private companies, whose management is said to leave much to be desired on the part of telephone users. The Government is having prepared a Bill to authorise the State to take over the entire telephone system. It is expected that £320,000 will be required for this purpose, and a further sum of £40,000 will be needed for the provision of new telephone equipment.

London.—Hackney.—The Works Committee of the B.C. reported on Monday that it was very annoying to find that no sooner had the Mare Street widening works, which had been in hand for two years, been at last completed than it was immediately found necessary by a Government department (the Postal Telegraphs) to serve notice for the breaking-up of the paved footway almost from end to end. The Committee, under the circumstances, had decided that the Postmaster-General should be informed that the local authority withheld its consent for the present to the proposed works.

Mexico.—A report has been issued by the German Government on "Latin America in 1904," which states that the receipts from telegraphs in 1904, in Mexico, were 10 per cent. in advance of the previous year's receipts, and that 1,500 kilometres of wire had been laid. Nine new telegraph offices were opened, and an underground cable 1,530 metres long was laid between Campeche and the terminus of the marine cable in the Gulf of Mexico. Wireless telegraphy had also been successfully adopted. Great efforts were made to repair the damage done by the exceptionally long rainy season, and much was done to extend the telegraph systems in the centres of population. In Puebla an underground cable of 21 wires was laid to unite the chief telegraph office with the outskirts of the town. Two telephone lines were erected in Sierra de Nacatete and in the harbour of Vera Cruz. In spite of the interruptions in the rainy season, 4 per cent. more telegrams were dispatched in 1904-5 than in the previous year.

Russia.—The *Morning Post* correspondent in St. Petersburg, on December 3rd, stated that the capital had been for the last three days in a state of semi-isolation as regarded not only foreign countries but also the greater part of the Empire. Even the telephone service to Moscow was interrupted. The Finland telegraph employés also struck, and closed the emergency channel. The Moscow employés sent the following telegram to the strikers in other cities and towns in Russia:—"All our demands are to be fulfilled. Continue the strike, and trust in victory. The prospects are good; Witte agrees to everything, and only Durnovo opposes. Remain firm until further notice." The inland telegraph service was reopened on the 5th inst., and the *Morning Post* on the 11th inst. stated that the telegraph was working between St. Petersburg, Moscow, Reval, Kieff, Kazan, Pskoff, Nijni Novgorod, Archangel and Narva, that many of the employés had resumed work, and it was believed the strike was collapsing.

The *Times* of yesterday states that, owing to the return of many of the postal and telegraph employés to their duties, the strikers have cut the telegraph wires at many places. The Railwaymen's Union has telegraphed to all railway stations in Russia to the effect that, if the Government tries to punish the railway telegraphists for refusing to transmit Government telegrams, the railways are to refuse to carry the Government mails.

South Africa.—The German Administration announces the opening of a new telegraph office at Tsumis, in German South-East Africa.

Switzerland.—There were 1,508,574 inland telegrams in 1904, this being an increase of 15,803. The International traffic sent and received amounted to 1,976,761 telegrams, being an increase of 99,134. Transit telegrams numbered 760,509, or an increase of 35,684. The total telegraphic traffic, therefore, amounted to 4,245,844 messages, being an increase of 150,621. Germany sent and received 657,721 telegrams; France, 519,201; Italy, 240,291; Great Britain, 143,542; Russia, 54,348; North America, 45,884, and Netherland Indies, 1,957,051. As regards telephonic conversations, there were 27,249,559 local; 5,790,764 between towns and 194,434 international conversations, showing increases of 7·94 per cent., 6·36 per cent., and 21·91 per cent. respectively. Germany's share of these was the largest, viz., 100,431, France following with 68,324. Receipts from telegraphs and telephones for 1904 were 10,022,389 fr. (£400,895) whereas the expenses were 10,705,536 fr. (£428,221) leaving a surplus of 683,146 fr. or £27,326.—*Journal Télégraphique.*

Telegraphic Interruptions and Repairs:—

	Interrupted.	Repaired.
Cables.		
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Cadiz-Tenerif	July 20, 1905	
Puerto Plata-Martinique	Oct. 30, 1905	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Kertch-Soutehoum	Sept. 27, 1904	
Communication with Brazil *via* Galveston	July 18, 1905	
Indo-European	Dec. 6, 1905	Dec. 6

Venezuela.—A Reuter message says, according to a *Herald* telegram from Caracas, President Castro's Note to the French Government asking it to state the reasons upon which it founded its protest regarding the action of Venezuela against the Cable Co. still remains unanswered. Later telegrams announce the refusal of France to withdraw her protest, but President Castro has offered to withdraw the Venezuelan note to which France took

exception if France withdraws the protest in question. The situation, it is said, is daily growing worse, and French patience is near breaking point, but Mr. Russell is still endeavouring to bring about a peaceful settlement.

Wireless Telegraphy.—South America.—The Government of Peru has decided to establish wireless telegraph stations from the capital of Lima in a westerly direction over the chain of the Andes as far as Iquitos, an important harbour on the Amazon River. The German Gesellschaft für Drahtlose Telegraphie has been granted a monopoly for the exercise of wireless telegraphy in the Republic of Peru, and two engineers are engaged upon the erection of the five stations. The locality of Puerto Bermudez on the eastern declivity of the Andes, which is the terminal point of the present telegraph system, has been chosen as the starting station for wireless telegraphy, and the distance from that place to Iquitos is approximately 620 miles. It is proposed later on to extend the wireless system over Brazilian territory to the mouth of the Amazon, and, in fact, first to the large river harbour at Manaos and then to Para. The execution of this contemplated extension would complete a system of wireless telegraphy between the Pacific and the Atlantic oceans.

Several remarkable and interesting experiments in wireless telegraphy were made recently on the railway line from Chicago to St. Louis. Two express trains were fitted up with the De Forest system. The signals sent by the telegraphs at Chicago and St. Louis were distinctly received on the trains which were going at 56 miles per hour. When, however, the trains crossed metal bridges the signals weakened considerably, and were undecipherable, whereas they were stronger when the trains passed near water. It was ascertained also that the signals were strongest when the train was ascending towards the sending station and weakest when going down an incline in the same direction. A special train fitted with the De Forest system now accepts telegrams for passengers, and communication is kept up with the train at St. Louis, Springfield and Chicago, and another station will be established at Bloomington if necessary.

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—December 18th and 19th. The Deputy Postmaster-General, Brisbane, invites tenders for the supply of insulators, phosphor bronze wire, copper sleeves, binders and tapes.

The Deputy Postmaster-General, Melbourne, invites tenders for the supply of (1) 10 miles of 26-pair lead-covered paper-insulated telephone cable; (2) 1 mile of 156-pair lead-covered paper-insulated telephone cable (12½ lb. conductors); (3) 5,000 barrel insulators, delivery within three months of date of acceptance of tender.

Austria.—December 20th. The Austrian State Railway authorities at Pilsen are inviting tenders until December 20th, for the establishment of an electric lighting plant at the railway station in that town.

Buxton.—December 15th. One 52-kw. gas-driven balancer set for the U.D.C. See "Official Notices" December 1st.

Clyde Navigation.—December 18th. Crane, electrically driven capstans, and tipping turntables. See "Official Notices" November 24th.

Grimsby.—January 5th. 500-kw. engine and dynamo, boiler, switchboard, and other plant and cables for Corporation electricity department. See "Official Notices" December 8th.

Islington.—January 1st. Suggestions for purification of water are invited by the B.C. electricity department. See "Official Notices" December 8th.

Launceston (Tas.).—January 15th. 500 or more electric meters; maximum demand indicators; for the Corporation. See "Official Notices" November 17th.

Plymouth.—December 23rd. Coal discharging and conveying apparatus for the Corporation electricity department. See "Official Notices" December 8th.

Spain.—January 30th. The Spanish Ministry of Public Works in Madrid, is inviting tenders until January 30th for the concession for the construction and working of an electric tramway between Santander and Astillero. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Obras Publicas, Madrid.

Stalybridge Joint Board.—December 18th. Advertising rights on 55 electric cars. See "Official Notices" December 1st.

Swindon.—December 19th. Three double-deck radial-axle truck tramcars for the Corporation. See "Official Notices" December 1st.

CLOSED.

Birkenhead.—The tender of Messrs. A. Reyrolle & Co., Ltd., for motor starters, in accordance with the specification of Mr. Wm. Bates, borough electrical engineer, during the period of 12 months commencing January 1st, 1906, has been accepted by the Electricity Committee.

Burnley.—The Electricity Committee has accepted the tender of the British Insulated and Helsby Cables, Ltd., for the supply of feeder pillars and accessories necessary for more readily locating faults which may occur in the lighting mains; also the tender of the St. Helens Cable Co. for the supply of 200 yds. of ·7 sq. in. cable for No. 8 engine at the works.

Canterbury.—The T.C. has accepted the tender of Messrs. H. Pooley & Sons, Ltd., for the supply of a 7-ton weighbridge for the electricity works, at £75.

Cape Town.—The following tenders were received for the electric light wiring and fittings at the new building for the National Mutual Life Assurance Association of Australasia:—

Clyde Engineering Co.	(accepted)	£445
Gorey & Co.		447
Koch & Dixie		448
G. Findlay & Co.		462
Cunningham & Gearing		465
Green & Trevett		470

The work comprises wiring and fittings for 130 points (in screwed conduit), also wiring for one 1-h.p. motor.

Clacton-on-Sea.—The U.D.C. on December 6th accepted the following tenders in connection with the plant needed for the power station:—

Davey, Paxman & Co., horizontal two-cylinder engines with Parker dynamos	£3,676
J. E. Spagnoletti & Co., switchboard	600
Johnson & Phillips, Ltd., cables	4,098
D.P. Battery Co., accumulators	1,450
J. McKay, Clacton, buildings	1,848

Glasgow.—The Tramways Committee of the T.C. have recommended for acceptance the following offers:—

Telephone switchboard, Ericsson Bell Telephone Co.
Gun-metal gland cocks, Dempster, Moore & Co.
Brass armature spindle caps, William Landell.
Extension of heating system, Coplawhill, Duncan Stewart.
Lorry axle arms and bushes, Atkinson Bros., Ltd.
Transfer figures, Tearne & Son.
Aluminium ribbon, W. H. Coe Manufacturing Co.
C.S. bogie-wheels, P. & W. MacLellan, Ltd.
Rubber boots, P. Paisley & Son.

India.—The East Indian Railway Co. have accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply of motors, transformers, and complete electrical plant for Lillooah.

London.—The Highways Committee of the L.C.C. have received the following tenders for the supply of conductor tee-rails for the first section of the northern tramways:—

Frodingham Iron and Steel Co.	(recommended)	£8,250
Bolckow, Vaughan & Co.		8,550
P. & W. Maclellan		8,612
Steel, Peech and Tozer		9,050

The tender of C. Wall, Ltd., amounting to £29,006, is recommended for acceptance for the erection of a car-shed at Poplar.

Hammersmith.—The B.C. has accepted an offer made by the Bat Electric Co. to sell 50 10-ampere meters, which were hired from them for the purposes of the exhibition at Olympia in October last, at £1 17s. per meter, the Bat Co. foregoing 5s. each, the hiring fee at the exhibition.

Pembroke (Ireland).—The London Electric Firm, of Croydon, have just received the order from Messrs. W. Lucy and Co., Ltd., of Oxford, for 45 complete sets of their "one working part" arc lamp lowering gear for street lighting here, the consulting engineers being Messrs. Robert Hammond & Son.

Portland Coaling Depôt.—The contract for conduits, feeder and arc lighting cables, underground boxes and lamp pillars, has been placed by the Admiralty with Messrs. Johnson and Phillips, Ltd.

Rochester.—It is stated that Messrs. Dick, Kerr & Co.'s tender for extending the tramway system at Rochester from Star Hill to Delce has been accepted by the Rochester Corporation.

Stafford.—The T.C. has accepted the tender of Messrs. Baxendale & Co., Manchester, for the ensuing year's supply of wrought-iron tubes and fittings for the electricity works.

(*Continued on page* 980)

THE BOW GENERATING STATION OF THE CHARING CROSS AND CITY CO.

With the near approach of another Parliamentary session, in which the great question of London's electricity supply will, undoubtedly, be a prominent feature, we feel that no more appropriate occasion can be found than the present, for a brief description of the later engineering developments of one of the best known of the existing supply companies, to wit, the Charing Cross, West End and City Electricity Supply Co.

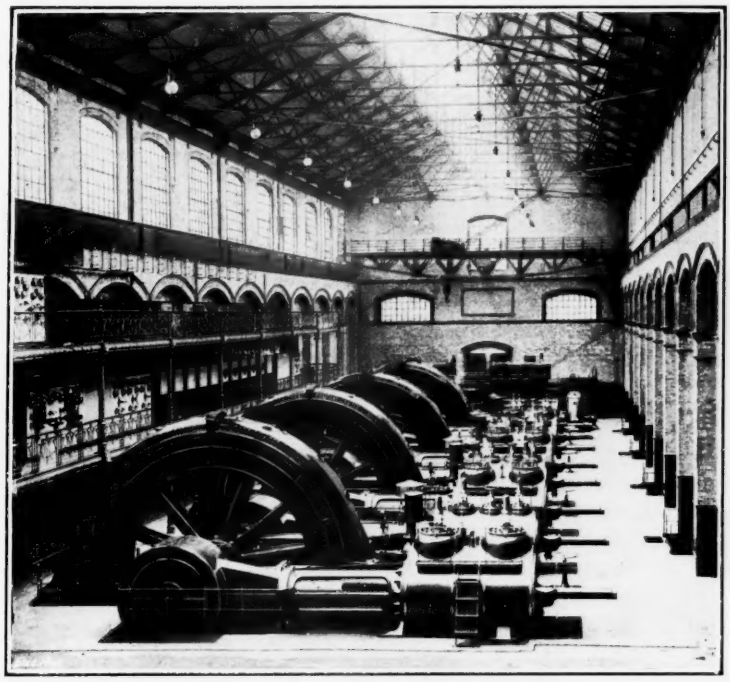


Fig. 1.—General View of Engine Room, showing 2,500 h.p. Sulzer-Lahmeyer Generators and the Switch Galleries.

The company's area, shown in fig. 2, extends some $3\frac{1}{4}$ miles along the northern bank of the Thames, and embraces important business and residential sections of the City and West End. The company can also supply in bulk to the Boroughs of Stepney, Bethnal Green, Poplar and West Ham.

As may be inferred from the districts supplied, the company's business is largely a lighting one, no less than 800,000 (equivalent) 8-c.p. lamps being connected, and this, in conjunction with the peculiar atmospheric conditions which characterise the London area, where a storm or fog frequently necessitates the placing in operation of some 7,000 kw. of plant within the short space of 20 minutes, to meet the sudden and temporary demand, enormously complicates the problem of efficient generation. During the year 1904, over $22\frac{1}{2}$ millions of units were generated by the company, and the maximum recorded load amounted to 12,140 kw. Happily, in Mr. W. H. Patchell the company possesses an experienced and able engineer, to whose credit stand many of the unique features of the company's plant; the present description is for the most part abstracted from his paper read before the Institution of Electrical Engineers on December 7th.

The company, known then as the Charing Cross and Strand Electricity Supply Corporation, Ltd., was registered in 1889, to work provisional orders granted in 1889 for St. Martin's; 1895, for the Strand, and 1898 for part of the districts of Holborn and St. Giles.

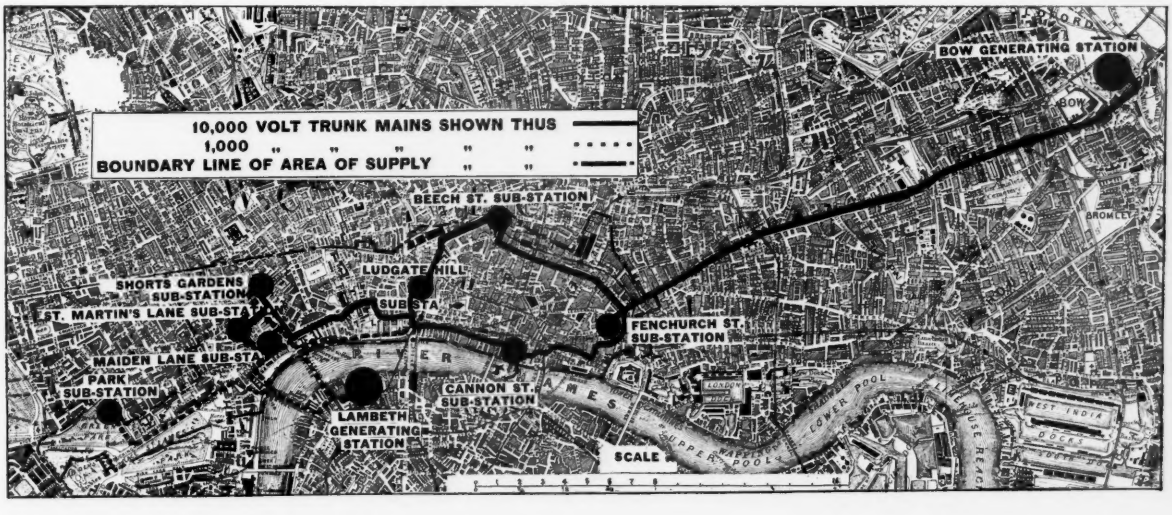


Fig. 2.—Plan of the Charing Cross, West End and City Electricity Supply Co.'s Area.

In 1899 the company obtained access to the City of London. Up to that time the supply was maintained from direct current generating stations at Maiden Lane and Lambeth, and the latter is still in operation for supplying the western portion of the company's area.

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The prospect, however, of a large demand for electricity in the City, and also the necessity of providing further generating plant in connection with the rapidly increasing West End supply of the company, led to the construction of the works at Bow, about 4 miles from the City and close to the main line of the Great Eastern Railway.

After consideration, a three-phase system of generation and transmission was decided on, necessitating the adoption of transforming sub-stations in the area of supply, as the demand in the City was for direct current, and the supply in the West End, which was to be augmented, was also direct current.

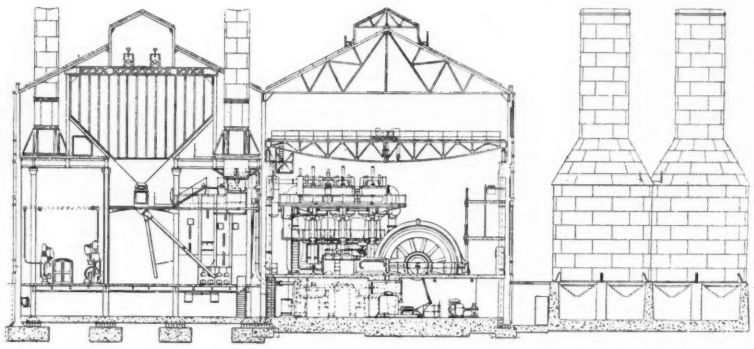


Fig. 3.—Sectional Elevation of the Bow Generating Station.

The highest pressure that could be directly generated by the machines and used by the motors, was adopted, with a view to eliminating the complication of static transformers and to save the extra space and switch-gear necessitated by them, and 10,000 volts was the pressure chosen with a periodicity of 50 cycles per second. At that time no direct generation at such a pressure was in use in this country, although various power and traction plants have since been put to work on these lines.

The generating station is illustrated in fig. 6 and a section and plan are shown in figs. 3 and 4. The building was laid out for a boiler room 75 ft. wide, with two rows of boilers facing each other, and coal bunkers of 7,500 tons capacity, overhead; and an engine room parallel to the boiler room also 75 ft. wide, with 36 ft. 6 in. clear under the traveller hook. The existing building is 300 ft. long, and the site is sufficient for the extension of it to 500 ft., and the provision of a similar building alongside.

In the boiler house (fig. 5) are installed three sizes of boiler, made by Messrs. Richard Hornsby & Sons, of Grantham. The boiler plant is all constructed for a working pressure of 160 lb. per sq. in. and is hand fired. The two smaller sizes are of the horizontal type and have heating surfaces of 4,590 and 8,100 sq. ft. respectively; grate areas of 62·5 and 125 sq. ft., and normal evaporations of 12,000 and 24,000 lb. of water per hour. The smallest size had already been in successful operation at the company's Lambeth Works for some years; the larger size was specially built for this work.

One pair only of the small boilers was put in, for light loads, these are fired in the usual way from the front only.

A novelty was introduced in the case of the larger boilers, where a grate was arranged in the ordinary way at the front and another at right angles to it, which could be fired from the side. These second grates have proved to be of enormous benefit when sudden fog or a thunderstorm has called for an extra supply of steam at very short notice. The ashpits for the two grates are quite separate, and are provided with the usual doors. At times of light load the boilers are fired from the front only, and the doors in connection with the side grates are all closed. As soon as the demand arises coal is thrown on to the side grates, the ashpit doors opened, and the extra fires are got away with surprising rapidity. The large heating surface in proportion to the grate worked at light loads, is an advantage, and the large size of boiler gives much less radiating surface per square foot of heating surface, than in the small sizes usually adopted.

Notice is also called to the special down-comers with mud-

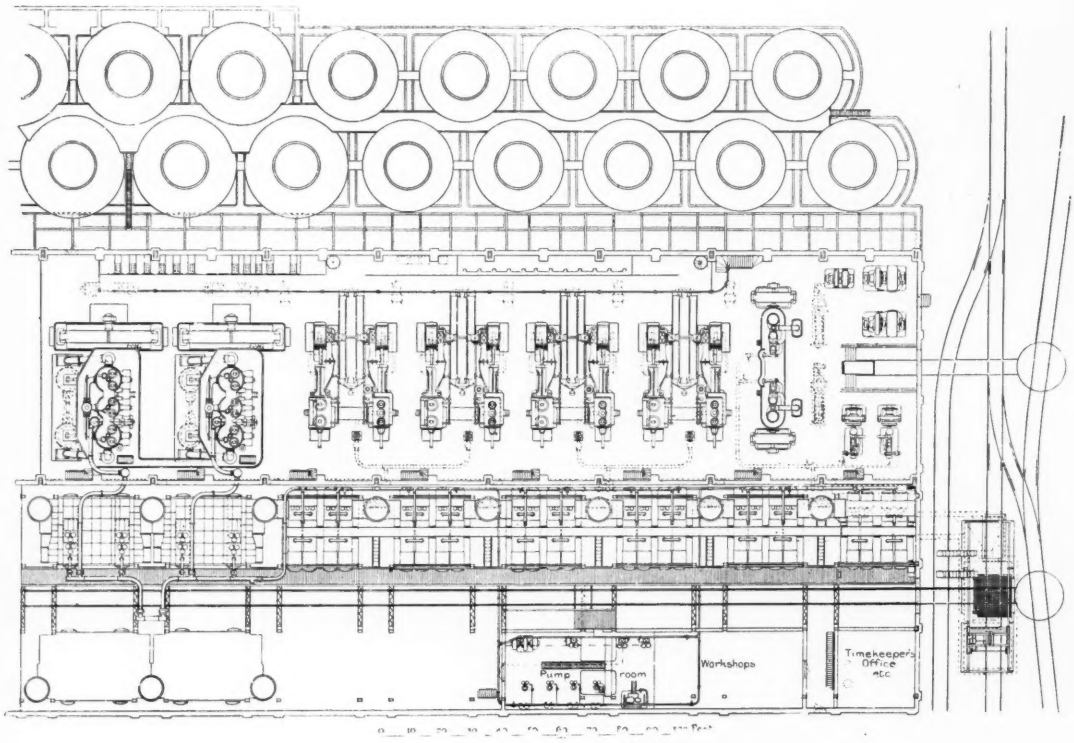


Fig. 4.—Plan of the Bow Generating Station.

drum and header, for the bottom rows of tubes immediately over the fire.

Each boiler is provided with its own superheater of the McPhail & Simpsons' type; in the small boilers they are fixed immediately under the drum, but in the larger boilers it was recognised that in this position the gases would be so low in temperature that the amount of heating surface to get the desired effect would have to be abnormally large. They were therefore put in about two-thirds of the way up the boiler, as will be seen on reference to fig. 9.

Last year a pair of Hornsby's "Upright" boilers were added, of the type shown in fig. 10, and they are erected as one steam unit, and form probably the largest steam-producing unit in existence. These boilers are also constructed for a working pressure of 160 lb. per sq. in. Each one has a heating surface of 10,850 sq. ft., and a grate area of 168 sq. ft.: the normal evaporation per hour being 33,000 lb. water. Each boiler in working order contains 78,440 lb. of water and occupies an area of 27 ft. × 18 ft. 9 in. Owing to the high temperature which would exist the type of setting was very carefully considered, and a wrought-iron casing with fire-brick lining was eventually adopted. In the fire zone the fire-bricks are 12 in. thick, while, higher up, tiles 6 in. in thickness are used, the brickwork being separated everywhere from the wrought-iron casing by 1 in. of magnesia.

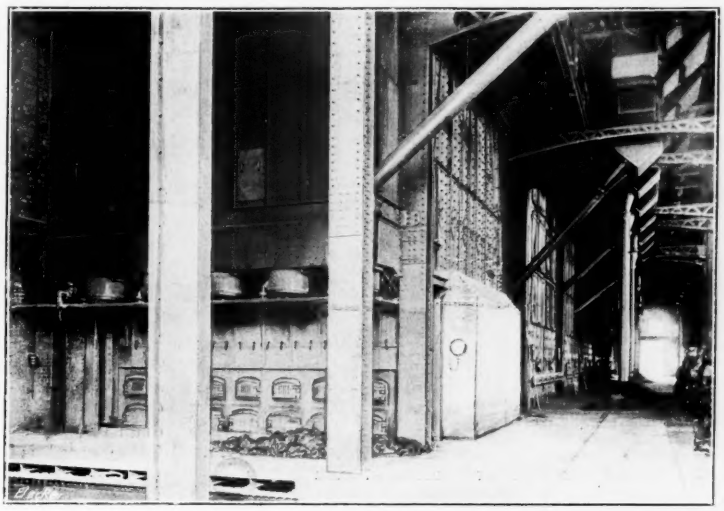


Fig. 5.—Boiler-House at Bow Station, Showing the Large Hornsby Combined Boiler-Unit in the Foreground.

The brickwork between the grates, which is honeycombed and carried up about 6 ft., becomes incandescent during working, and its effect, combined with the ample combustion chamber, ensures a much more perfect combustion than is obtained in the horizontal type of boiler. Coal which might give heavy smoke when burned under the horizontal boilers can, with no more care taken in the hand-firing, be burned without smoke in the "Upright" boilers.

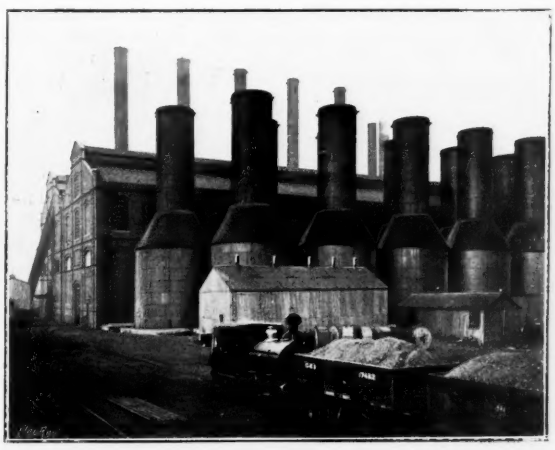


Fig. 6.—General View of the Bow Generating Station.

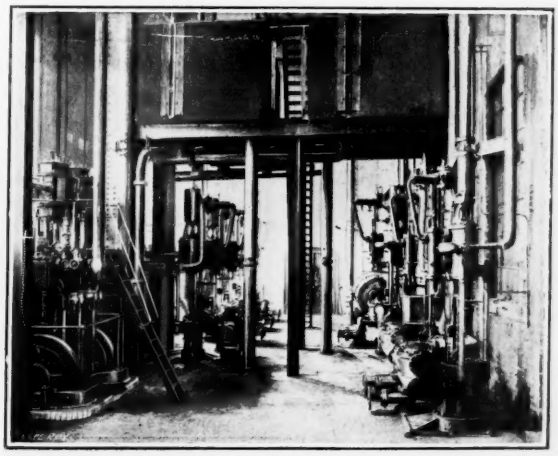


Fig. 7.—View of the Pump Room.

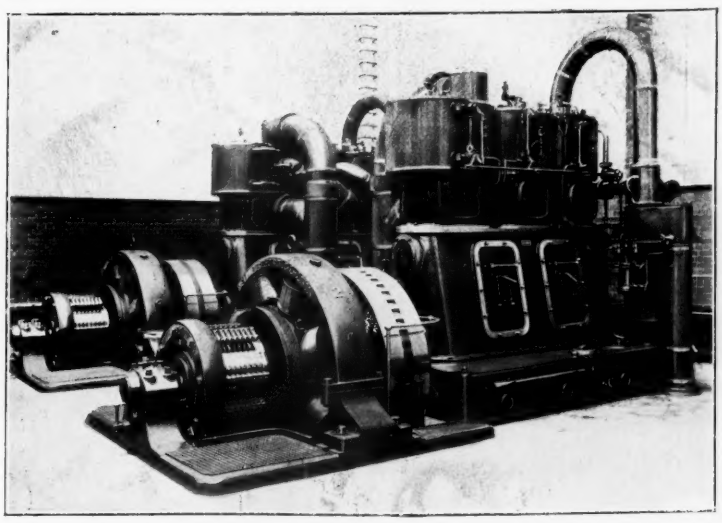


Fig. 8.—Belliss-Lahmeyer Exciting Plant.

In the case of these boilers the ashpit is divided, so that only a part or the whole of the fire-grate can be used as desired, with a similar benefit to that described above.

The upright tubes are a great improvement on the horizontal, both as regards external and internal cleanliness. The back sections act as water-heaters or economisers with a definite circulation, any scale or sediment is deposited in them, and the front sections kept quite clean.

The pair of "Upright" boilers last erected have been steamed at the rate of 100,000 lb. per hour, and so will easily provide steam under ordinary working conditions for

a 4,000-KW. generating set. Superheaters are also included with these boilers, and can be seen in fig. 10.

With a view to economising ground space, eight steel chimneys, each about 120 ft. high and 7 ft. 6 in. diameter, have been erected, supported on the steel girder work of the building over the firing floors between the boilers. The gases from adjacent boilers are led into the chimneys by short breeches pieces, each leg of which is fitted with a regulator. This gives the gases an almost direct route from the grate to the top of the chimney.

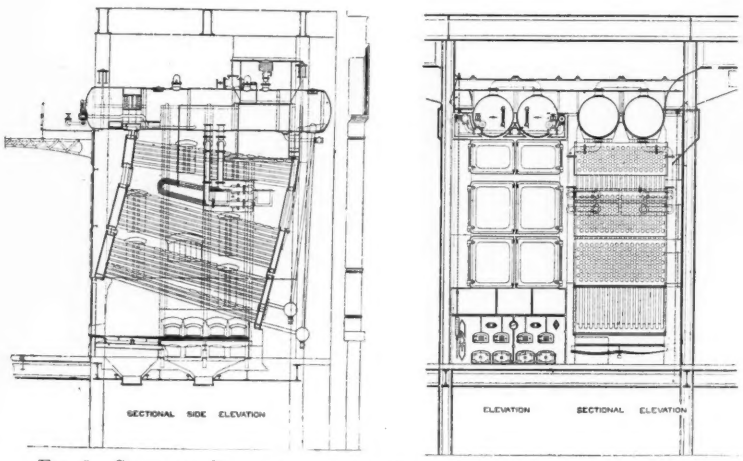


FIG. 9.—SECTIONAL ELEVATIONS OF THE HORNSBY HORIZONTAL TYPE BOILER.

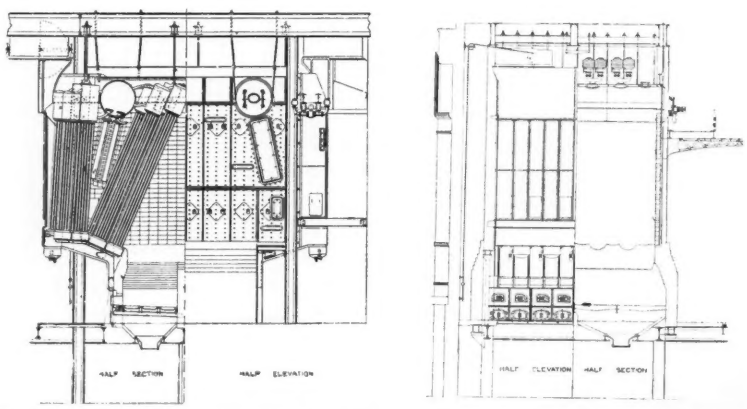


FIG. 10.—SECTIONAL ELEVATIONS OF THE HORNSBY VERTICAL TYPE COMBINED BOILERS.

As mentioned above, the boiler house was laid out for two rows of boilers in view of the larger engine units to be put in later. One row suffices to supply steam to the horizontal engines, which leaves the space opposite them available for lavatories, office, workshop, and pump-room.

The water supply for the station is derived from two 13-in. Artesian wells on the premises, 400 ft. deep, which each yield 15,000 to 20,000 gal. per hour, as required. The method of pumping adopted is the air-lift system, and the water raised is discharged into a large reservoir in the basement below the pump-room; the latter is illustrated in fig. 7. From this reservoir the water is pumped by Woodeson slow-speed compound steam pumps to a tank at the top of the building; it runs back by gravity through the water heaters at the various engines to a tank over the pumps, into which also the exhaust steam from the latter is discharged, and to which all the feed-pump suction-pipes are connected. There are also alternative suction pipes direct into the reservoir in the basement. The feed-pumps are all of the Woodeson slow-speed compound type made by Messrs. Clark, Chapman.

Turning to the generating plant, the first to be ordered consisted of two 800-KW. sets and two 1,600-KW. sets, followed almost immediately by two further 1,600-KW. sets. Last year a 4,000-KW. set was added, and a similar set has just been put to work.

The engines driving the 800-KW. generators (fig. 15) are three-cylinder triple-expansion, quick-revolution, enclosed engines of Messrs. Belliss and Morcom's well-known type, with cylinders 19, 28 and 43 in. in diameter, and a stroke of 20 in. Their speed is 230 r.p.m., and they will normally develop 1,120 B.H.P. They exhaust into jet condensers in the basement, the pumps for which are driven by electric motors.

The engines driving the 1,600-KW. generators are of the horizontal cross-compound type, by Messrs. Sulzer Bros., of Winterthur, see figs. 11 and 13. The H. and L.P. cylinders are $34\frac{3}{8}$ and 61 in. dia. respectively, with a $59\frac{1}{8}$ in. stroke. These engines are rated at 2,500 B.H.P., and have a speed of 83·3 r.p.m.

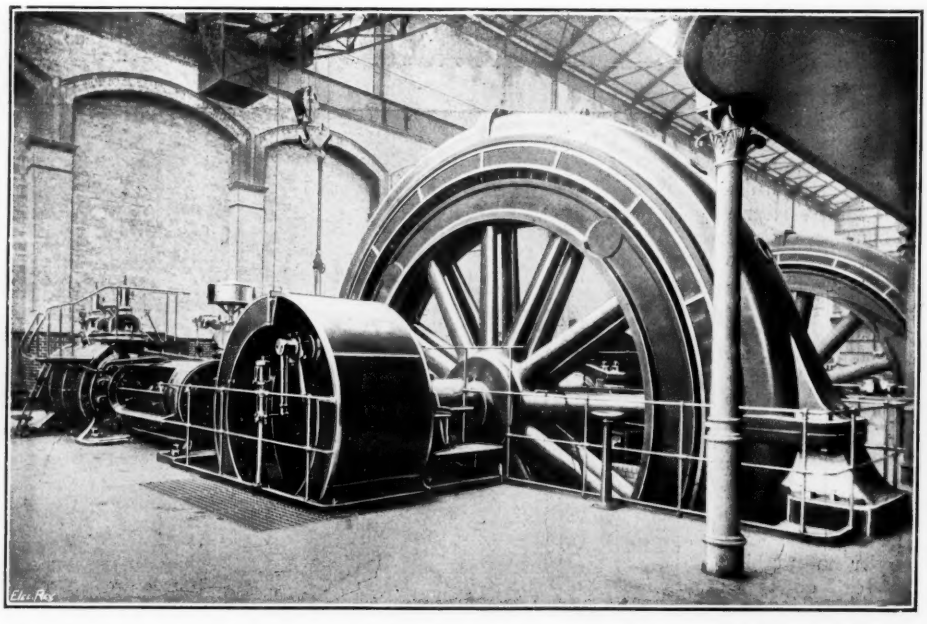


FIG. 11.—2,500-H.P.-1,600-KW. SULZER-LAHMEYER THREE-PHASE GENERATOR: END VIEW.

For comparison, it may be noted that, including the generator, the floor space occupied by the complete set is 1,128 sq. ft. In details they differ materially from the usual type of slow-

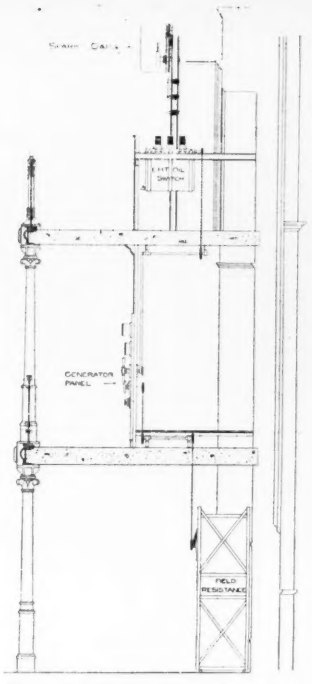


Fig. 12.—Section through H.T. Switch Gallery.

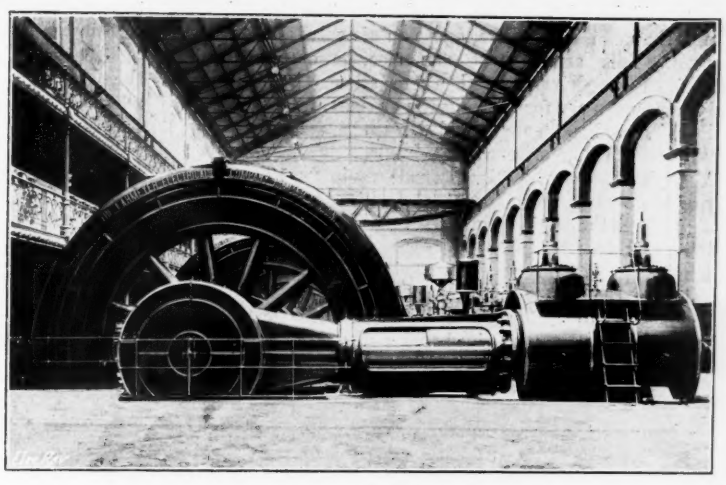


Fig. 13.—View of 1,600-kw. Sulzer-Lahmeyer Generator.

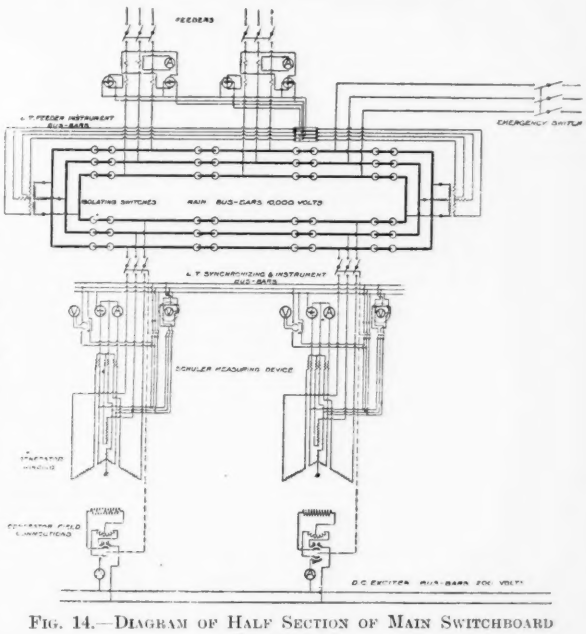


Fig. 14.—Diagram of Half Section of Main Switchboard Connections.

speed engine, inasmuch as the connecting rods and cranks are enclosed, and the oil supply is continuous and under pressure.

The valves are of Messrs. Sulzer's latest four-seated pattern. The pistons are provided with tail-rods, and are supported outside the cylinders by special bearings. The cranks are set at 108° instead of the more usual 90°, with the low-pressure crank leading. The exhaust steam from the low-pressure cylinder is divided in an oil separator and taken to two jet condensers, one on each side of the engine. These condensers stand on their air-pumps, which are driven from the high and low-pressure crankpins respectively.

The engines driving the 4,000-kw. generators (fig. 16) are of the vertical three-cylinder compound type, with a 50¼ in. diameter high-pressure cylinder in the centre and a 70⅝ in. diameter low-pressure cylinder on either side, driving on to cranks which are equally placed. These engines, which have a 51½ in. stroke, and a speed of 83·3 r.p.m., developing nominally 6,000 b.h.p., are, we believe, the largest in use for such a purpose in this country. An engine itself weighs some 450 tons and occupies 540 sq. ft. of floor space, the vertical overall height being 33 ft. 4 in.

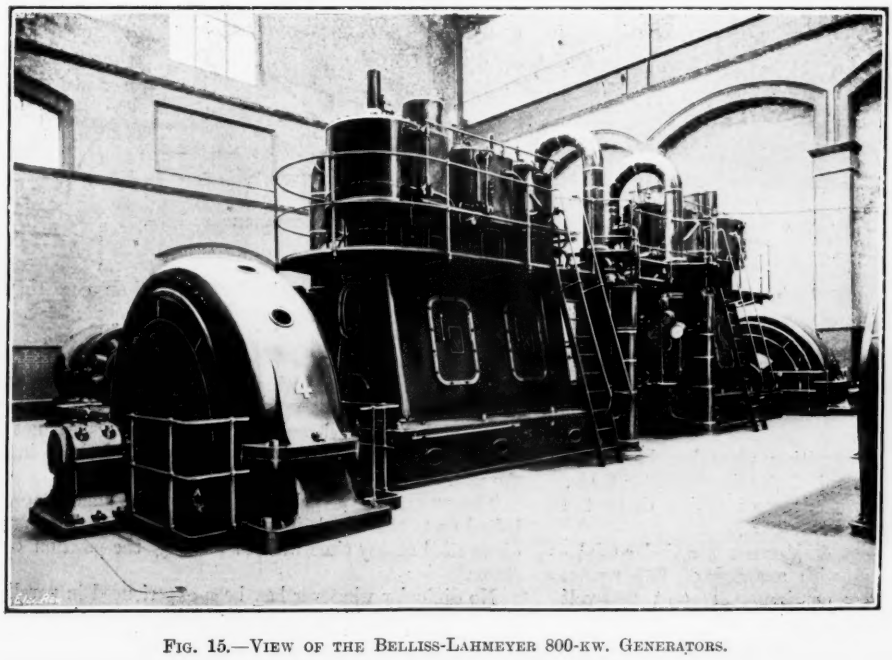


Fig. 15.—View of the Belliss-Lahmeyer 800-kw. Generators.

The piston rods, cross heads and connecting rods are entirely enclosed to prevent splashing. The oil is supplied under pressure from a tank above the cylinders, and after running through the engine bed to a filter tank in the basement it is returned to the tank at the top by pumps and used over again.

The valves are of the four-seated type, as used on the horizontal engines. Main and afety governors are

both provided, and the latter in addition to automatically closing the main steam valve, opens an air valve to break the vacuum. This arrangement can also be operated by a lever from the driver's stand, where all the hand wheels and levers necessary for working the engines are assembled.

Two jet condensers are provided, with separate air-pumps driven from the low-pressure cross-heads.

A special feature which is shown clearly in fig. 17, and has proved thoroughly satisfactory, is the adoption of feed-water heaters on all the engines, inserted between the low-pressure cylinder and the jet condenser.

The air pumps deliver into steel hot wells, and from the latter the water is drawn by centrifugal pumps, direct coupled to motors, and delivered into the cooling towers. The vacuum obtained under normal working conditions is between 25 and 26 in.

two 350-KW. motor-generators (fig. 18), similar to those used in the City sub-stations, and by a Hart storage battery.

The generators are all of Messrs. Lahmeyer's make, of the rotating field type. The magnet wheels of the 800 KW. sets are provided with 26 poles wound with copper wire, while the larger 1,600 and 4,000 KW. sizes have each 72 poles, with windings of flat copper (edge wound).

The larger machines have stators 27 ft. and 29 ft. in diameter respectively, and the diameters of the magnet wheels are 23 ft. and 25 ft.

The number of slots per pole per phase in all the machines is two.

The stator frames were all bored out in the vertical position in which they were subsequently erected.

The winding is in mica tubes, embedded in slots which are nearly closed. Crossings of the wires are, as far as possible,

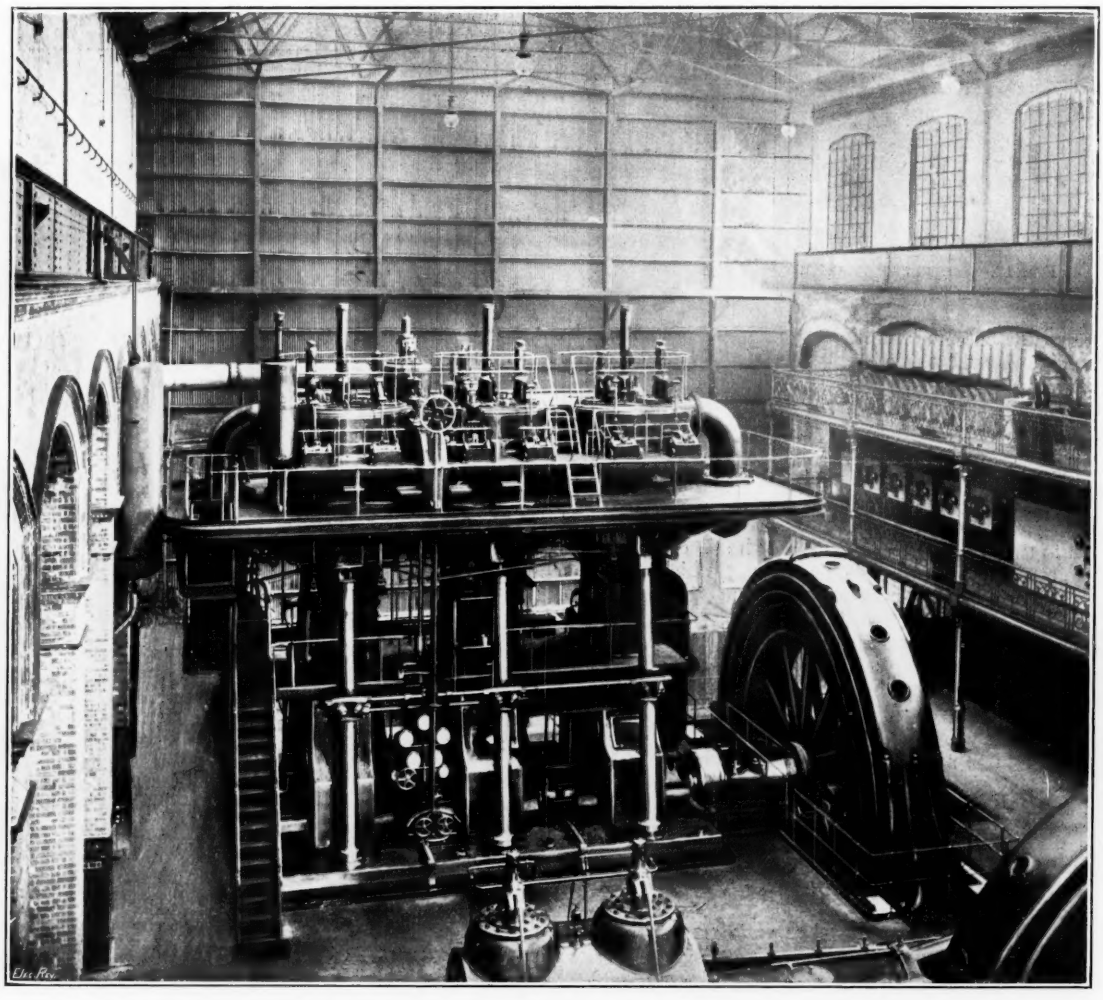


FIG. 16.—VIEW OF A 6,000-B.H.P.-4,000-KW. SULZER-LAHMEYER GENERATOR, INSTALLED AT BOW.

The cooling towers have steel circular shells and each has a capacity of 25,000 lb. of steam per hour on easy working.

Figs. 3, 4 and 6 show the general arrangement of the towers, which are 30 ft. in diameter, 38 ft. high to the base of the cone where the water is delivered into them, and 85 ft. high to the top of the chimney.

A small continuous current exciting plant has been provided to supply the energy required for the generator fields, station lighting, and the various motors which drive the circulating pumps, coal cranes, travellers, &c.

This includes two Belliss & Morcom 3-cylinder triple-expansion 350-B.H.P. engines, with a speed of 365 r.p.m., driving 300 KW. Lahmeyer continuous current 200-volt dynamos (see fig. 8), and exhausting into the same condensers as the 800 KW. sets. These are supplemented by

avoided, and where the coils leave the iron core they are carefully wound over templates and covered over with insulating tape to prevent breakdown between adjacent coils or between the coils and the frames.

The rotors or magnet wheels, which also serve the purpose of fly-wheels, are built up of four parts, held together by means of bolts and shrunk rings. Such rings are not only used at the hubs, but also at each side of the joints on the rim.

The wrought-iron poles are solid, of circular shape, and bolted on to the wheels in such a manner that they may be dismantled at any time without altering the position of the stator.

No difficulty whatever has been experienced in paralleling the 800 KW. machines driven by high-speed engines with the larger machines driven by slow-speed engines.

The main switchboard is at one side of the engine room, arranged in two distinct halves, which, however, may be connected by an emergency switch. The generating plant is numbered consecutively, each of the odd numbers being connected to one-half of the switchboard, and the even numbers to the other half.

Fig. 12 is a section through the switchboard. The resistances for the fields of the machines stand on the main engine room floor: the panels carrying the controlling gear are upon the principal gallery, and the high-tension switches are placed on the upper gallery, and worked positively from the gallery below, by levers.

At first, chimney type switches with fuses in series were used, but as experience showed that they were not reliable in connection with large machines and long cables, they were replaced by oil switches, which are also fitted with relays to act as automatic cut-outs.

The measuring of the high tension circuits is done under Messrs. Lahmeyer's Schuler patents, in which one coil of the generator is taken out to a one-to-one transformer, and from the secondary side of this transformer low tension circuits are taken to the measuring instruments.

Each machine has its own panel complete, which carries its main switch lever, synchronising lamps, field ammeter, main voltmeter, wattmeter, and watt-hour meter; and each trunk main panel carries a wattmeter, ammeter, and watt-hour meter.

The halves of the switchboard have their own E.H.T. ring bus-bars, which can be divided into sections by suitable links.

Fig. 14 is a diagram of one half of the main switchboard connections, showing the emergency switch by which the other half may be connected. The two sets of bus-bars are kept distinct with their own allotted machines and feeders: selector switches, by which the machines or feeders can be thrown on to either bus-bar, are not employed.

Cable charging gear is provided to run up the cables to working pressure or to test them at 15,000 volts.

A three-phase generator, driven by a D.C. motor, gives a current at a normal 2,000 volts pressure. This current is stepped up by a bank of two three-phase oil transformers, and the pressure is varied by varying the field of the 2,000-volt generator. Special bus-bars and switches are provided in connection with the charging gear, so that a cable may be run up and then put in parallel with other

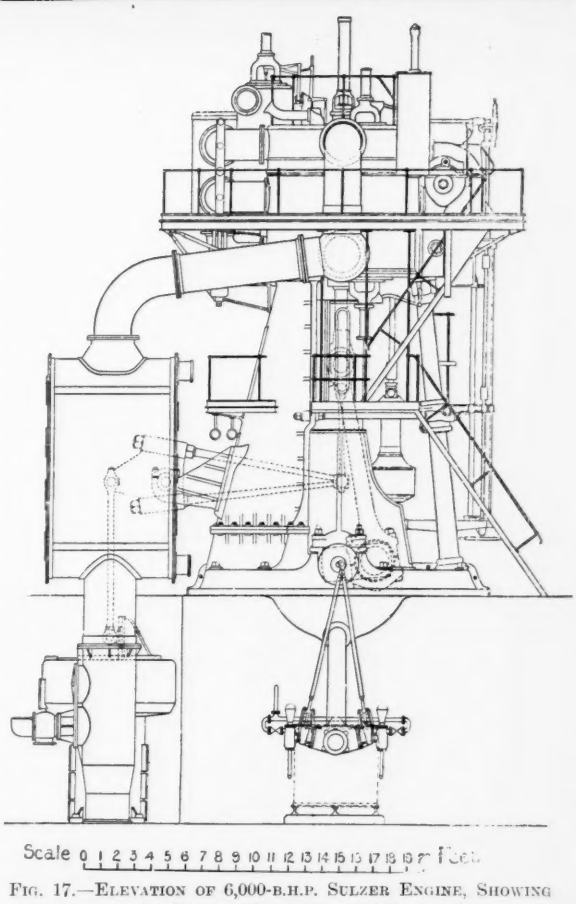


Fig. 17.—Elevation of 6,000-b.h.p. Sulzer Engine, Showing the Exhaust-Feed-Water Heater.

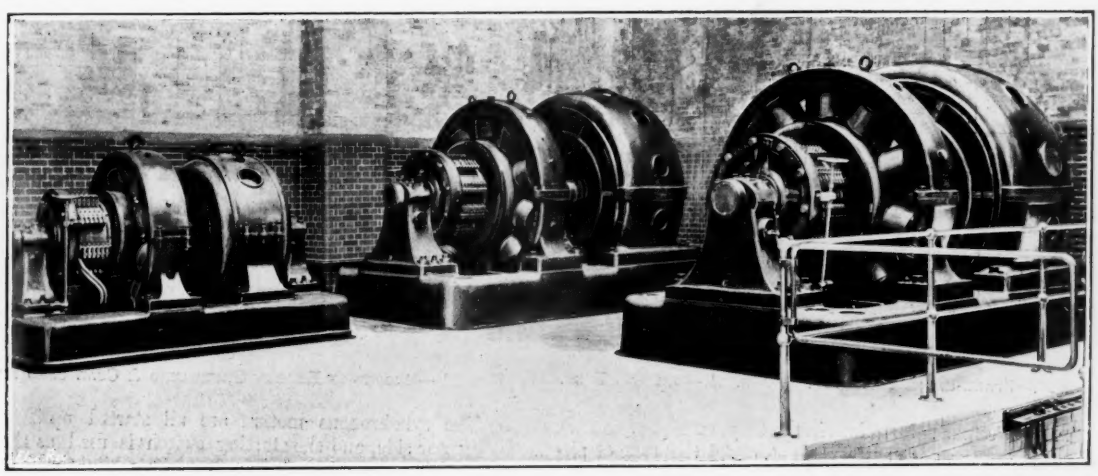


Fig. 18.—Lahmeyer Motor-Driven Exciters and Testing Motor-Generator at the Bow Station: Similar Motor-Generators are Installed in the Sub-Stations.

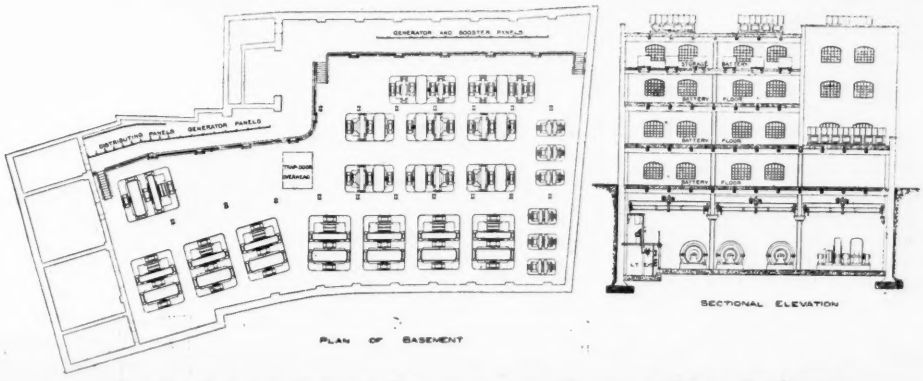


Fig. 19.—Plan and Sectional Elevation of the Fenchurch Street Sub-Station.

working cables, or a working cable may be taken off the main bars and discharged for testing or other purposes.

Ten three-core, lead-sheathed, paper-insulated trunk feeder mains at present leave the generating station. Six of them go to the City and four go to the West End; means of interconnecting the City cables and the West End cables are provided in the City. The cables are laid on the solid system in steel troughs, which are heavily bonded to comply with the Board of Trade requirements. The cables have a half-inch of insulation between conductors and between conductors and earth, so that they can be worked either with the middle point earthed or unearthed as desired. Although over 70 miles of such cable has been installed there has only been one cable fault.

No joint boxes were allowed to be built on the route of the trunk mains; special joints, therefore, were designed which could be made in the steel trough without increasing the size of the trough or unduly diminishing the thickness of bitumen between the cable and the trough. Several types were tried, the form selected is shown in fig. 23.

It will be noted that it consists of two ebonite disks to keep the three cores in position; short copper sleeves were sweated over the three cores and a lead sleeve wiped on over all and filled up with cable compound. Further experience showed that the ebonite disks were better replaced by porcelain disks of the modified type shown, which give a longer path for creepage, the form of lead sleeve also was improved.

In order to overcome the trouble due to the heat, in filling the troughing on the solid system, short funnels were temporarily tacked on to the sleeve, and after the trough had been filled the insulating material in the sleeve was topped up, the funnel cut off, and the hole covered over.

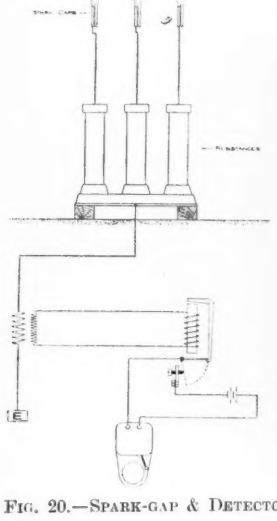


Fig. 20.—Spark-gap & Detector.

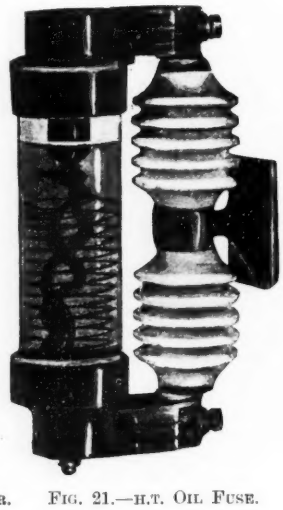


Fig. 21.—H.T. Oil Fuse.

There are four sub-stations in the City, each provided with motor-generator and battery plant. As the type of plant used in each is the same a description of the Fenchurch Street sub-station will suffice.

Fig. 19 shows a plan of the basement and a sectional elevation of the building, which is arranged for machines and switchboards in the basement: the ground floor may subsequently be used as a battery room; the floors over are laid out for batteries.

This building will take motor-generator plant of 8,400-kw. capacity, and battery plant of 1,600-kw. capacity on a four hours' rating.

The E.H.T. mains are brought to the E.H.T. chamber underneath the switchboard platform, and are there connected through oil fuses to ring bus-bars. Each motor is connected to the bus-bars through oil fuses and a Siemens and Halske chimney type switch, which are also fixed in the E.H.T. chamber. The switches are controlled positively by levers from the machine-operating panel on the switchboard platform above.

Each motor-generator has its own standard panel complete. Main switches, ammeters, voltmeters, also field switches and ammeters, are provided for both the motors and generators.

A synchronising gear of voltmeter and lamps combined, is provided for the synchronous motors, and the motor field switches are omitted on the panels for induction machines.

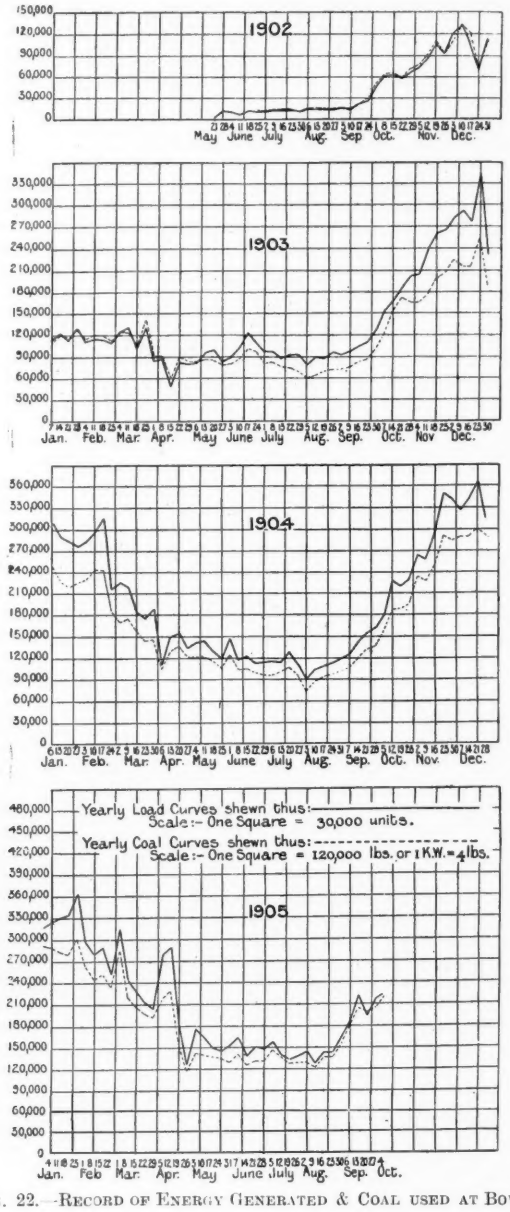

1902
May June July Aug. Sep Oct. Nov. Dec.
1903
Jan. Feb. Mar. Apr. May June July Aug. Sep. Oct. Nov Dec.
1904
Jan. Feb. Mar. Apr. May June July Aug. Sep. Oct. Nov. Dec.
Yearly Load Curves shewn thus:—
Scale:- One Square = 30,000 units.
Yearly Coal Curves shewn thus:----------
Scale:- One Square = 120,000 lbs. or 1 K.W. = 4 lbs.
1905
Jan. Feb. Mar. Apr. May June July Aug. Sep. Oct.

Fig. 22.—Record of Energy Generated & Coal used at Bow.

The synchronous motors are all started up from the generator side, and the starting switch is used as the main switch for one pole of the generator, while the induction

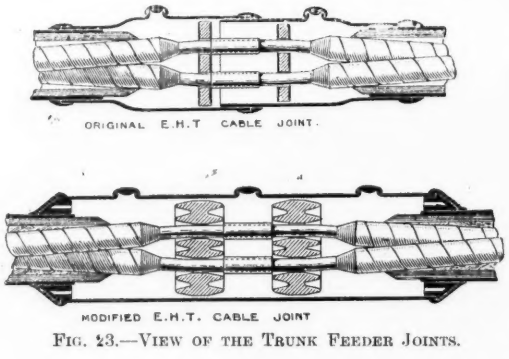


Fig. 23.—View of the Trunk Feeder Joints.

motors can be started alternatively from the generator side or from the motor side, and are fitted accordingly.

Induction motors are preferred in some quarters, because

they can be started up more quickly, and it is believed that in the event of an accident they will maintain their load better than synchronous machines; the latter, however, are preferred by some engineers because of their better power factor. The regulation of the direct-current side can be managed equally well with either type of machine under normal conditions. With rotaries, the regulation is not usually sufficiently good for a high-class lighting load.

In this case synchronous motors were selected for the majority of the machines with one or two induction motor sets in each sub-station. In all cases the motors are wound for the full pressure of 10,000 volts, with a uniform size of motor of 500 H.P. and a speed of 300 r.p.m.

The motors in some cases drive 350-KW. generators wound for the full pressure, 400 to 440 volts, across the "outer" wires, and in some cases, two generators each of 175 KW. capacity, which are wound for 200 to 220 volts, and are used as balancers on the three-wire system.

The batteries at Fenchurch Street at present comprise 204 cells, each of 4,000 ampere-hours' capacity at a four-hour rate, made by the Tudor Accumulator Co.

No end-cells are used, their place being taken by reversible boosters. The ordinary pressure from the "outers" of the distributing network is used for running the motors, and they are thus available at all times, no matter whether the E.H.T. plant is running or not.

The conditions obtaining are met by hand-regulating, as automatic regulation, although excellent for tramway purposes, would not be so convenient for the work in question.

Practically no movement of the brushes is required from no load to full load of 1,200 amperes. The latest construction is even better, as in it the generator machines are provided with compensating poles, and can be run from full load in one direction to no load, and up to full load in the other direction, without moving the brushes or showing any signs of sparking.

In the battery rooms, floors of concrete screeded over with a hard cement, smoothed off and tarred with two coats of Stockholm tar have proved both cheap and efficient

The supply into the districts presents little novelty. The Ludgate area was first supplied from the western districts of the Charing Cross Co. at 100 volts on each side of the three-wire system, by simply extending the existing network, and supplementing the supply from the old sub-stations with a temporary plant in Ludgate sub-station. Before Bow generating station was started there were more than 50,000 lamps supplied in this way: the pressure, therefore, was unaltered until this year, when it was doubled. The other three districts of the City, Fenchurch, Cannon Street, and Beech Street, are all supplied at the higher pressure. At present some 12,000 KW. of A.C. motor-generators alone, are installed in the company's sub-stations, while the battery capacity in the City is some 16,000 ampere-hours, at 400 volts pressure.

The feeders and distributors are paper insulated, lead-covered cables laid on the solid system, with spareways into which further feeders can be drawn as required. Each feeder is provided with an automatic cut-out in the sub-station, and the distributing networks supplied by separate feeders are interconnected through enclosed type fuses.

General Working Results.—The Bow plant began to run in May, 1902. Fig. 22 showing the weekly output of B.T.U. generated and coal used, is interesting, as it indicates the value of the plant more truly than any other tests.

The units and coal are plotted on a 1 to 4 scale, and it will be noticed that almost throughout the coal used is less than 4 lb. per unit.

The coal used at first was large Welsh, but in the second half of 1904 small Welsh began to be used in gradually increasing quantities, and through the winter not much more large coal was used than was necessary for lighting the fires, and a little on the peak. During the year 1905 the quantity of large coal used had been infinitesimal.

Before a type of switch and fuse for the generating station was decided upon extensive experiments were made, and a type of fuse was developed which has operated most satisfactorily; it is shown in fig. 21. It will be noted that, while it is an oil fuse, the actual fuse wire is above the surface of the oil and covered by a little insulating chamber, which contains the metal vapour until it is blown under the surface of the oil as the bottom terminal of the fuse is dragged away by the action of the spiral spring.

The substitution of oil switches for the chimney-type switches in the generating station rendered the retention of fuses there unnecessary, but this type of oil fuse is now being used throughout the sub-stations.

It has also been found that under working conditions, in the event of a circuit being opened through, for instance, the action of a fuse, a surge is likely to occur, and that it would be safer to provide spark-gaps. The common form of horn type spark-gap was experimented with and abandoned in favour of a spark-gap of the type shown in fig. 20, which has carbon on the one side and copper on the other. The travelling of the spark up the parallel portion of the horns is increased by the chimney action of a glass enclosure, and the result of many tests has been to show that they may be calibrated and set with much greater accuracy than the ordinary bent wire horn type.

The resistances consist of earthenware vessels filled with a solution of glycerine and water.

The width of spark-gap employed is 4·5 mm. for 10,000 volts working pressure, *i.e.*, 5,800 volts between each phase and earth, with the centre of the star earthed. A spark will jump the gap at 12,000 volts when the horns are clean and the atmosphere normal.

With a view to obviating occasional and irregular working of the spark-gaps, a detector apparatus was added, consisting of a small transformer with its primary inserted in the earth wire of the spark-gap resistance, without adding appreciable self-induction to the circuit, and a relay which is actuated by the secondary and rings a bell, or it could equally well mark a time recorder.

When a discharge occurs, the relay shutter falls, causing the bell to ring, and so calls the attention of the switchboard attendant, who notes on a report form the exact time, and whether any change in switching or alterations in the conditions of running were made. These reports are collected and examined with the running logs of the other stations, when frequently the effect in one place can be directly traced to the cause in the same or another place.

Irregularities when starting up machines, although not sufficient to affect easy synchronising or switching in, are prolific causes of spark discharges.

On two occasions small measuring transformers have gone to earth; faulty insulators have also caused interruptions, and on nearly every occasion discharges have been reported, which emphasises the fact that sudden interruptions cause surges all over a system. Another curious fact is that, after a failure the spark-gaps have acted for some time after all obvious indications of the trouble were over, from which it would appear that a system takes some time to recover from a severe shock.

In conclusion, we wish to acknowledge our indebtedness to Mr. W. H. Patchell, the company's engineer and manager, whose valuable paper before the Institution of Electrical Engineers, we have so largely drawn on in this description.

Our best thanks are also due to Mr. H. W. Kingston, his assistant, for much time and trouble expended on our behalf.

Single-Phase Motor-Cars at Berlin. — The new electric motor-cars, which are to serve as models for the cars to be used on the Hamburg-Altona railway and eventually on the Berlin city and suburban railways, have now been equipped in the Tempelhof workshop and conveyed to Nieder Schönweide in order to begin their trials on the Spindlersfeld railway. There are two cars, each of which has three axles, and the two cars form a train unit, although the latter can be enlarged by the addition of other cars. Each car is fitted with motors of 115 H.P. capable of giving a speed of 31 miles an hour. The single-phase alternating current has a line pressure of 6,000 volts, which is transformed to 750 volts on the cars, the overhead collection being effected by means of two bow-shaped trolleys on each car. Electric lighting and heating arrangements are provided in the cars, which give accommodation for 115 persons seated. On the completion of the trials, it is proposed to build 50 other cars of the six-axled type, for the Hamburg-Altona railway.

CONTRACTS CLOSED.

(*Concluded from page* 970.)

Torquay.—The T.C. has accepted the following tenders for the supply of additional plant for the power house:—

Siemens Bros. & Co.	£5,168 15
Tudor Accumulator Co.	1,966 0

Warrington.—At the meeting of the T.C. on December 6th, objection was taken to the acceptance of the tender of Messrs. W. Rouse & Son, Heckmondwike, for the supply of four top covers for tramcars, at £279 18s. 6d., it being urged that the tender of Messrs. McDowell, a local firm, should have been accepted. It was pointed out that this tender was £20 higher, and did not provide for the electrical fittings. The next lowest tender, which included the electrical fittings, was that of Milnes & Co., Birkenhead, at £380.

West Ham.—The Corporation have placed an order with Messrs. Babcock & Wilcox for four chain-grate stokers, at £248 per boiler.

Wolverhampton.—The Corporation has entered into a contract with the Sirdar Rubber Co., Ltd., for the supply and maintenance of tires for the motor-omnibuses for 12 months.

FORTHCOMING EVENTS.

To-day's Events (Friday, December 15th).—At 7 p.m. Physical Society. An Exhibition of Electrical, Optical and Physical Apparatus.

At 8 p.m. Electro-Harmonic Society. Smoking Concert and Presentation of Souvenirs to the members of the Electrical Exhibition Executive Committee.

At 8 p.m. I.M.E., at Storey's Gate. Adjourned discussion on seventh report to the Alloys Research Committee by Dr. H. C. H. Carpenter and Messrs. R. A. Hadfield and P. Longmuir.

At 8 p.m. Junior Institution of Engineers. Prof. J. T. Morris on "Electric Mains for Power Transmission Work."

At 8 p.m. I.C.E. (Students). Mr. E. E. Mann on "Tests of Street Illumination in Westminster.

At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Mr. W. F. Parish, jun., on "The Engineering Value of Lubricating Oils."

Saturday, December 16th.—At 7.30 p.m. Glasgow Technical College Scientific Society. Mr. W. D. Hamilton on "The Economy of Power Production—Relative Merits of Gas and Steam Engines for Various Purposes."

At 10 a.m. Junior Institution of Engineers. Visit to Messrs. Johnson and Phillips's Old Charlton Works.

I.E.E. (Manchester Students). Visit to Stuart Street generating station. Meet at Queen's Statue at 2 p.m.

Monday, December 18th.—At 8 p.m. Society of Arts. Cantor Lecture by Dr. J. A. Fleming on "The Measurement of High Frequency Curves and Electric Waves." (Lecture IV.)

Tuesday, December 19th.—At 8 p.m. I.C.E. Mr. H. A. Mavor on "Heat Economy in Factories."

Wednesday, December 20th.—At 2.30 p.m. I.C.E. (Students). Visit to the works of the Euston extension of the C. & S.L.R.

Thursday, December 21st.—At 8.30 p.m. Chemical Society. Meeting.

Friday, December 22nd.—At 7.30 p.m. I.E.E. (Manchester Students). Mr. J. C. Ward on "The Electrical Equipment of Automobiles."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are announced:—

Monday, December 18th.—"A" Company, recruits' drill, 6 p.m.; technical instruction, 7 p.m.

Tuesday, December 19th.—"B" Company, technical instruction, 7 p.m.; medical inspection, recruits, 7 p.m.

Wednesday, December 20th.—"A" badge examination.

Thursday, December 21st.—"C" Company, technical instruction, 7 p.m.

Friday, December 22nd.—"D" Company, technical instruction, 7 p.m.

Headquarters will be closed from 11 p.m., Friday, December 22nd, 1905, until 10 a.m., Monday, January 1st, 1906.

J. H. S. PHILLIPS, Captain E.E.
For O.C.E.E.R.E. (V.).

Water Power in Germany.—A memorandum has been prepared by the Ministry of Public Works, in regard to the proposed utilisation of the water power which will be available on the execution of the works for the canalisation of the Moselle and the Saar. It is pointed out that the Moselle on Prussian territory will yield about 35,000 H.P., the Lorraine section 5,000 H.P., and the Saar approximately 10,000 H.P., or a total of 50,000 H.P. This total will only gradually be brought into use, as new industries would have to be established to create a demand, and as the iron and steel works in Lorraine and the Saar already use the blast furnace gases for power purposes. It is considered that the establishment of water-power stations would be the means of affording a cheap supply of power, especially as the utilisation of water-power has engaged but little attention in Germany, down to the present time.

NOTES.

Christmas, 1905.—Will all of our friends kindly take note of the following arrangements which have been made to facilitate the production of our issue of December 29th, the Friday after Christmas.;—

Articles and correspondence for publication should, as far as possible, reach us by Saturday morning, December 23rd.

Late correspondence and notes and notices should be received by us on the morning of Wednesday, December 27th, as usual.

Our advertisement department announces that:—

New advertisement copy and alterations to existing advertisements, should be received not later than Friday morning, 22nd inst.

Official Notices and small prepaid advertisements will be in time if received by noon on Thursday, December 28th, as usual.

The Borough Polytechnic Institute.—The thirteenth annual distribution of prizes and certificates took place on Monday evening, December 4th. The newly-appointed chairman, Mr. J. Leonard Spicer, presided. He said the work of the Institute was going forward with great strides, and he feared that, even allowing for the magnificent additions to the buildings which had recently been made, the governors would again be faced with the problem of knowing how to house the students. Although the word "Polytechnic" was associated in many minds with recreation and amusements, the chief work of these institutes lay in an educational and technical direction, £15,000 a year being the least sum on which the work at the Borough Polytechnic can be carried on at present. Mr. C. T. Millis, the principal, read the annual report, which showed that the percentage of passes gained in examinations was higher than last year, and the total value of scholarships was £375. Certificates were gained in applied mechanics, magnetism and electricity, steam, machine construction, plane and solid geometry, and practical mathematics; every candidate entered from the Institute for the examination in steam was successful. A satisfactory feature of the work of the Institute was the readiness with which intending students asked for and followed advice given as to their courses of study, and the increasing number of those students who attend for two, three and four years. After the certificates and prizes were distributed by Lady Lockyer, Sir Norman Lockyer delivered an address. He said that the sums spent on education in Germany and America considerably outweighed what was considered a sufficient amount in England, and it must be realised that if learning was to progress in this country, we should have to pay for it. Prof. Perry claimed for the Polytechnic Institutions of London that they were doing a work which was unprecedented, and which our Colonies were now endeavouring to imitate. He had just returned from South Africa, where he found the people following the lead which London was now giving in the matter of technical education.

The Electrical Volunteers and the Charing Cross Disaster.—With further reference to the excellent work done by the Electrical Engineers Volunteers last week (see p. 938, ELECTRICAL REVIEW), the following has been sent to us officially:—

"The following particulars of the call and turn-out made by the search light sections of the Corps of Electrical Engineers on the night of the disaster at Charing Cross, show what has already been effected in the direction of organised mobilisation in this section of the Auxiliary forces.

"On the night of the accident a call was telephoned to me, the officer commanding, at 6.25 p.m. The orders were issued from the headquarters and the sections warned at 6.35. Two sections under Capt. Phillips and Lieut. Sheppard were mobilised with two 24-in. projectors, all lamps, cable reels, and without waiting for horse transport these were dragged through the streets by the service drag ropes, got into position and the beams turned on the damaged roof and walls at 8 o'clock, being a total of 95 minutes from the time the call was started from Charing Cross.

"These lights have been in continuous action during the hours of darkness ever since the disaster.

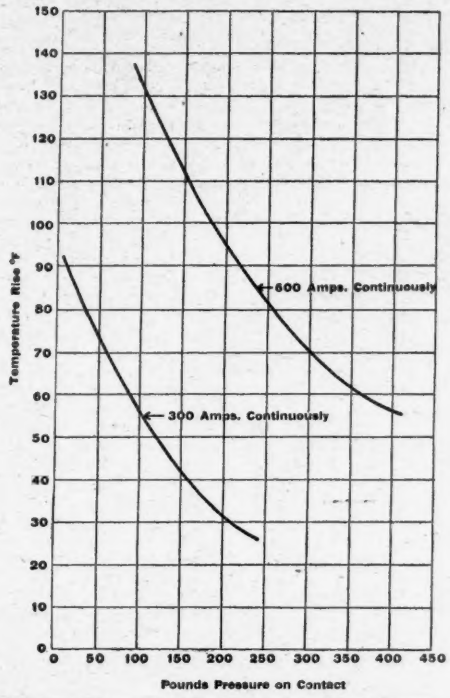
"R. E. B. CROMPTON, *Lieut.-Colonel*,
"*Officer Commanding, Electrical Engineers, R.E. (Vols.)*

Overhead Mains.—The central station at Heimbach on the Ruhr, which recently commenced to supply the pumping plant of the Mechernich Mining Association, has now extended its operations so as to include the town of Aix-le-Chapelle, *vid* Blatten, Stockheim, Lendersdorf, Gurzenich, Mariaweiler, Langerwehe, Rohe and Haaren. Bare overhead mains carried on masts are employed for the transmission of the current, which is effected at a pressure of 30,000 volts. At Aix-la-Chapelle the current is stepped down at a transformer station to 5,000 volts, and at this pressure it is conveyed to the municipal electricity works which distribute the energy to consumers either in the form of three-phase current or, after conversion, as continuous current. The town of Duren has also been brought into the scheme, and other towns in the same industrial area are installing plant for undertaking distribution from the bulk supply works. The masts carrying the overhead wires have affixed to them tablets warning persons of the danger of touching the wires.

Electric Welding.—On 6th inst. the Steel Barrel Co. opened their new barrel and tank factory at Uxbridge for inspection. The various parts of the barrels, &c., are welded together by means of electricity.

Automatic Train Control.—A paper on this subject was read at a Students' meeting of the I.E.E. on November 29th, by H. G. Trust, in which the author dealt with the Westinghouse electro-pneumatic multiple-control system; the Westinghouse unit-switch control; and the Sprague-Thomson-Houston multiple-unit train control, in detail.

In the discussion a note was communicated by Mr. T. H. Schoepf on the subject of pneumatically-operated electric switches, giving the results of a series of tests which were obtained with these. The switch closes with a quick and steady motion, the contact pieces first closing at or near the tip, and as the piston rod moves forward the contacts roll and slide one on the other, finally resting at the heel and under the full pressure of the air against the piston. This motion between the switches has the effect of keeping the contact pieces perfectly clean, with the result that the carrying capacity of the switch is always a maximum. This condition, he



Westinghouse Electro-Pneumatic Unit Switch.

said, could not be obtained with a system operated electrically or electro-magnetically, since the pull on the moving arm of the switch varies inversely as the square of the distance of the core from the centre of the magnetic circuit, and therefore the switches come up with a very severe slam, tending to work the contacts loose, no matter how securely they are fastened to the switch, and the shock naturally shortens the life of the entire apparatus. The figure shows two curves giving the results of temperature tests which were obtained upon a switch having contacts 1 in. in width and with various pressures on the contact. The piston was 2¾ in. in diameter, and the several pressures on the contact were obtained by varying the pressure per sq. in. of the compressed air admitted to the cylinder.

Oscillographic Tests at Bow Generating Station.—In the appendix to Mr. W. H. Patchell's paper on the Charing Cross Co.'s City of London Works, which is dealt with elsewhere in this issue, a number of oscillographic records were reproduced. These showed that the wave-form of the alternators was very satisfactory at both full and light loads. With certain of the City feeders connected (unloaded) the 11th and 13th harmonics were clearly shown, but dangerous resonance was not, nor is it likely to be, approached. The worst condition is met with when a small alternator is connected with several unloaded feeders. Switching individual cores on and off produced a maximum instantaneous value of 9,800 volts, nearly twice the R.M.S. value (5,000), so that it should be safe to switch on a feeder on open circuit at 10,000 R.M.S. volts—if the insulation will stand 20,000 R.M.S. volts, this gives a margin of safety of 40 or 50 per cent. Sudden changes of voltage on the cable, or current in the machine, are dangerous, especially on open circuit; thus it is dangerous to switch on an unloaded feeder, or suddenly to cut out a heavy load if by so doing a lightly-loaded feeder is left connected to the generator. The occurrence of arcs or sparks of any sort in the circuit is especially to be avoided, as it may lead to the development of voltages sufficiently high to break down the insulation. In order to avoid such dangers, charging gear has been provided for switching feeders in and out.

Profit Sharing.—The *Toronto Globe* reports that the British Columbia Electric Railway Co., under a profit-sharing arrangement, has distributed $15,600 among 390 employés, as representing the men's share in the profits for the year ended June 30th, 1905. This experiment in profit-sharing is said to be proving quite satisfactory both to the employés and to the company.

The Electrical Engineers (Volunteers).—The non-commissioned officers' mess held its annual dinner at Anderton's Hotel on Saturday, December 9th, C.S.M. A. Marshall in the chair. Among those present were Capt. Dumble (Adjutant), Major Leaf, Captains Le Rossignol, Pierce and Bransby Williams, and Lieuts. Sheppard, Leys, Tolley and Thorne.

After "The King," the Chairman, in proposing "The Officers," made reference to Col. Crompton's evidence before the Defence Committee, from which important developments for the corps are expected; he also referred to the assistance given by Capt. Pierce and the staff at the disaster at Charing Cross. Major Leaf, in responding, alluded to the steady increase in numbers, which had now reached 700, to the general good feeling which existed between all ranks, and to the loss of officers owing to their being appointed to important posts, both civil and governmental, abroad.

Replying for the Permanent Staff, Capt. Dumble, in a racy speech, said that nowadays he had little to do, as the N.C.O.'s seemed to run the corps themselves, while Sergt.-Major Gunn told of the time when he had only one recruit to drill, and that with borrowed rifles.

In proposing "The Sergeants' Mess," Lieut. Sheppard said that the talent for effective organisation shown by its members, and their habit of looking ahead, were qualities which could not be too highly commended. He also gave testimony to the advantage of all officers having passed through the lower ranks.

During the evening C.S.M. Marshall, the mess president, was the recipient of a handsome electric standard lamp and an autograph book from his comrades, on the occasion of his marriage. Quartermaster Sergt. Applebee made the presentation in a neat speech, to which the recipient suitably responded.

An excellent programme of music enlivened the proceedings of the evening.

Glasgow Technical College.—The annual report of the work of the Glasgow and West of Scotland Technical College shows that the college has maintained its satisfactory position; during the 1904-5 session there were 530 day students, 4,424 evening students, and others, making a total of 5,671, as against 5,333 last year. The "student-hours" amounted to 406,221. There were 118 graduates of Scottish and English Universities in attendance, showing the value attached to the instruction given. Good progress is being made with the new building; the total expenditure to date has been £163,060, and the building fund now stands at £209,763. The College has received a legacy of £20,000 under the will of the late Mr. J. Donald. Dr. A. L. Mellanby has been appointed to the Chair of Prime Movers, in succession to Prof. W. W. Watkinson. Prof. M. Maclean occupies the Chair of Electrical Engineering.

The N.E.M.A. Electrical Trades Benevolent Institution.—The National Electrical Manufacturers' Association (Incorp.) at a general meeting held at the Hotel Cecil on the 4th inst. accepted rules as submitted by the Committee for this Benevolent Fund. These rules are about to be printed and circulated. The following gentlemen were elected to serve on the Committee of the Benevolent Fund, with power to add to their number up to 30:—

H. Bevis.	Justus Eck.	C. S. Northcote.
J. B. Birnbaum.	T. J. Grainger.	H. Oppenheimer.
Herbert H. Berry.	E. F. Johnson	W. L. Packenham.
G. Braulik.	P. A. Lundberg.	W. Schmahl.
E. J. Clark.	F. H. Nalder.	L. Thurnauer.

Donations as follows were promised at the meeting:—General Electric Co., Ltd., £100; International Electric Co., £25. Smaller donations were promised by 14 others.

The fund starts with £260 as the gratifying result of a first attempt. To this will be added a good sum from the surplus of the Electrical Exhibition at Olympia. The members of the Committee, in addition to personal donations of £10 each, have pledged themselves to raise £100 each for the fund. No doubt, when the complete rules are before the trade, there will be considerable additional assistance forthcoming from those who have not as yet had an opportunity of examining or showing practical sympathy with the scheme, which is to grant pensions and temporary relief to deserving and necessitous persons (or their widows and families) who have been connected with the electrical trade of the United Kingdom.

There are, of course, other funds in existence of a somewhat similar kind, namely, the Institution of Electrical Engineers' Benevolent Fund, which has £2,050 invested, and the Institution's Wilde Benevolent Fund of about £1,500—both for the benefit of present and past members of the Institution and their families; and the B.E.T. Electrical Superannuation Fund for B.E.T. and allied companies, with which several other concerns are also connected.

The Manufacturers' Fund will be run in the interests of the electrical trade workers generally—a need that is naturally not met by the other funds above mentioned.

An Electrical Volunteer Rifle Company at Bangalore.—The *Times of India* says that it has been proposed to form a company of Electrical Engineers in connection with the Bangalore Rifle Volunteers. Instruction will comprise telegraphy, telephone, engine-dynamo, lighting, searchlight and mining work. Certificates are to be given to men who become efficient and expert for which 26 and 36 drills a year will be required instead of the usual nine to qualify for the capitation grant. Moreover, there will be good prospects of employment in connection with the industries that are growing daily, from the output of electrical power at the Cauvery Falls. Mr. H. P. Gibbs, chief electrical engineer to the Mysore Government, will command the company, with Mr. A. S. Andrews, electrical contractor, as lieutenant.

Energy and Momentum.—The following remarkable letter and report have come to hand as we go to press:—

19, Imperial Buildings,
Ludgate Circus, E.C.
December 13th, 1905.

Editor of the Electrical Review,
4, Ludgate Hill.

Dear Sir,

Enclosed I send you the report of the momentum engine by Mr. W. J. Harding, M.I.C.E. The report simply means that the modern accepted theory of energy is false, that it is proved to be a farce, and I say worse than that, that a fund was established in the sixties for exploiting false science. The reason for it was simply that the key to universal electric light, heat, and power is spelt Power. You can have no idea how proud I am, as a born Englishman, that it has fallen to that race to discover the mechanical manufacture of power. There is an old saying in the world that "I smell MICE." When an inventor before a lot of engineers should show one-fifth of power delivering 30 per cent. of power, and then by mechanical construction *in the face of the theory of energy* add to the machine and deliberately deliver from one-fifth, 33 per cent., four-fifths never attached to the line shaft. Eminent men should have smelt a MOUSE.

Kind regards,
Yours faithfully,
B. C. Pole.

[copy.]

Consulting and Inspecting Engineer.
Telegraphic address, "Howadji, London."
Telephone number, 6217 Central.

60, Mansion House Chambers,
11, Queen Victoria Street, London, E.C.,
December 12th, 1905.

B. C. Pole, Esq., C.E.

Dear Sir—

Momentum Engine at Alexandra Palace.

With reference to your request as to the result of my observations on above:—

Indicator diagrams show that, the engines working non-condensing, there is a back pressure in the cylinders of 10½ lbs. at 275 r.p.m., steam on engine side of stop valve 80 lbs. Max. i.h.p. 24.

Engines have eight cylinders, single acting, 4½ in. dia. × 4 in. stroke of piston.

Lights lighted, which may be verified at any time, 739 from 5 to 8-c.p., 20 16-c.p., one 32-c.p., together with two arc lamps, say, 10 amperes—voltage 105.

Inspection of the voltmeters and ammeters at any time show that by using the ordinary rules for obtaining e.h.p. a paradox is apparent, the i.h.p. being less than the e.h.p.

Faithfully yours,
(Signed) W. J. Harding, M.Inst.C.E.

The ridiculous mouse that Mr. Pole has brought forth fills him with pride; we may point out, however, that the old saying is misquoted. One says, "I smell a *rat*"—and we think "RATS!" would have been most appropriate. We shall have more to say on the subject in our next issue; in the meantime we can only refer our readers to our issue of November 1st, 1901, for the report of the action brought against us by Mr. Pole, in which we proved his claims to be fallacious.

Electric Shock Fatality.—On Monday, according to the *Liverpool Post and Mercury*, Mr. Coroner Brighouse resumed his inquiry at the Bush Hotel, Ince, near Wigan, relative to the death of David Evan Jones, 20, a drawer, employed in the Yard Mine of the Ince Hall Colliery, Ince. On November 14th deceased was working on a road along which an electric cable ran. One of the tubs he was taking to the shunt got off the road, and the cable became entangled in the angle iron of the tub, and, while deceased was attempting to get the tub back on to the rail, the sharp corner of the angle iron of the tub cut through the insulation of the cable, the result being that the deceased received an electric shock. and he was found dead under the tub. Mr. Henry Knight, the colliery manager, explained that the installation had been laid down for three years, and that was the first accident they had had. Dr. Fletcher, of Ince, stated that he had made a post-mortem examination. The deceased was a perfectly healthy man, and there was no doubt death was due to an electric shock. Mr. Hall, Government inspector, said no rule had been broken, but he thought some effective steps ought to be taken by using an armoured cable, or that the very best expert advice should be sought and acted upon. The jury, after considerable discussion, found a verdict of "Accidental death," no blame attaching to anyone. They left it in the hands of his Majesty's inspector and the colliery management to make such arrangements as would make the installation as safe as possible.

Micanite Litigation.—With reference to the several paragraphs which have appeared in this journal, especially in our issues of November 21st, 1904, and November 7th, 1905, we understand (from Messrs. G. Schulz & Co., the London agents) that Messrs. Microwsky & Co. have successfully defended the action brought against them by the Mica Insulator Co. for infringement of all classes of mica patents in Germany. In view of the uncertainty which may exist in the mind of many of our readers as to the exact position of the actions which have taken place, we are asked to mention this, notwithstanding that there are at the present moment actions by the Mica Insulator Co. for infringement in this country which are still pending.

Northampton Institute.—The annual prize distribution at this Institute took place on Friday evening last, Mr. L. B. Sebastian, the chairman of the governors, presiding. In presenting the annual report of the work done by the Institute and its 5,000 students, Dr. R. Mullineux Walmsley, the principal, once again referred to the necessity for increased accommodation, applicants having to be turned away during last session. He stated that there were under consideration proposals for enlarging the Institute by the erection of an additional building. The presentation of prizes and certificates was performed by Sir W. H. Preece, F.R.S., who delivered an address, in the course of which he had something to say on the question of technical education, remarking, among other things, that, notwithstanding the better technical education of the foreigner, the young Englishman was in demand abroad, because of his self-reliance and his power of command. As usual on these annual events, the various laboratories, workshops, &c., were thrown open for the benefit of visitors, who inspected much of the ordinary work of the Institute in progress. The social and recreative side of the Institute was represented in the gymnasium and the swimming bath, where displays were given. The annual conversazione took place on the following evening (Saturday).

In addition to the usual demonstrations of work in progress in the various departments, musical entertainments, &c., a special feature was found in a series of beautiful and interesting experiments carried out by Dr. C. V. Drysdale and his assistants in the electrical laboratories. Stroboscopic methods of measuring speeds have in his hands received an extraordinary development, and have rendered possible the performance of experiments which have hitherto presented great difficulties, such as the accurate determination of the retardation curve of a motor armature running free, the slip of induction motors, &c. The arrangements made for testing transformers, both single and polyphase, energy meters at all loads and power factors, motors, &c., in the laboratories are admirable. Mention must be made also of a 25-kw. alternator which has been made for the most part in the workshops of the Institute, and is arranged in such a way as to enable a number of interesting problems to be thrashed out when the machine is completed. A visit to the laboratories would prove of interest and instruction to any electrical engineer, and Dr. Drysdale's enthusiasm would prove an excellent tonic after the worry of the daily round.

Institution and Lecture Notes.—Birmingham and District Electric Club.—The annual meeting was held on Saturday last. The report of the committee—the first since the club's initiation—showed very satisfactory progress, the membership being 82. A number of useful papers have been read, and social meetings and works visits have taken place. Mr. J. A. Jeckell was elected president for the ensuing year, and Mr. Riddle (of Inniss & Riddle, City Chambers, New Street, Birmingham) was appointed secretary, Mr. M. G. Waggott having retired from that position.

Institution of Civil Engineers.—At the meeting on Tuesday, the 5th inst., a paper was read on "The Steam Turbine," by the Hon. Charles A. Parsons, C.B., F.R.S., and G. G. Stoney, MM.Inst. C.E. The general theory of the working of the steam turbine was given, and the chief features of the flow and expansion of steam and the conditions essential to economy were touched upon. Various applications of steam turbines were dealt with, and a large part of the paper dealt with the application of the steam turbine to marine propulsion.

At the Albert Hall, Nottingham, on 7th inst., Prof. W. E. Ayrton, F.R.S., lectured on "Energy and Patriotism: British, American and Japanese." From a report of the lecture in the local Press, we gather that the Professor had nothing good to say of the present-day Englishman.

The danger of incandescent electric lamps in the mine was discussed at a meeting of the North of England Mining and Mechanical Engineers, held in Newcastle on Saturday. The subject arose out of experiments made by Mr. Holliday, of Littleburn Colliery, where an outbreak of fire had been traced to this cause. Mr. Blackett said he never could understand how people imagined that there should be no heat in an electric light, and Mr. J. B. Atkinson, Mines Inspector, quoting from a book on explosives written by himself and his brother, showed how coal dust in the upper parts of mines, probably due to its absorption of oxygen, very easily becomes ignited. In the discussion it was urged that incandescent globes should be enclosed, as they were on their original introduction into mines, in outer cases.—*Yorkshire Daily Post*.

Manchester Engineers' Association.—Mr. E. G. Constantine, consulting engineer, of Manchester, and an ex-president of the above Association, read a paper at a meeting of that Association on Saturday last, on the subject of "Steam and Steam Generators." He referred, in the course of his remarks, to water-tube boilers as having been extensively adopted in the generation of electricity, and quoted particulars of the relative numbers of different types of boilers now in use in the 348 electricity stations in the United Kingdom. Of stations equipped with water-tube boilers exclusively there are 38·5 per cent.; with mixed shell type and water-tube, 24·4 per cent.; with Lancashire boilers, 24·1 per cent.; with shell-type boilers, other than Lancashire, 13·0 per cent. In the electricity generating industry, a system of keeping costs, under the heads of installation, fuel, attendance and maintenance, is adopted—a system which might be advantageously followed in some other trades, for, if more attention were paid to the cost of steam generation, the resultant saving would be enormous. Taking the average price of coal at 8s. 6½d., it appeared that stations equipped with shell-type boilers, other than Lancashire, had the

least coal cost, ·36d. per unit sold, the wages of workmen being ·04d., and cost of repairs ·02d. higher than in Lancashire boiler stations. The next stations in economy of coal per unit were those provided with mixed shell-type and water-tube boilers, the cost of coal being ·409d., while repairs and maintenance were ·05d. per unit higher than in the case of Lancashire boilers, the wages of workmen being the same. On the same basis the cost of coal per unit in stations equipped with water-tube boilers was ·44d. per unit, or ·01d. less than in Lancashire boiler stations, the wages of workmen being ·01d., and repairs and maintenance ·03d. per unit greater. This comparison goes to show that there is no practical difference in cost of fuel and repairs and maintenance per unit of electricity sold, in the stations equipped with Lancashire boilers and those with water-tube boilers. These results, Mr. Constantine remarked, would probably come rather as a surprise to the advocates of Lancashire boilers, and also to those whose experience agreed with his own that water-tube boilers of the best design, are alone equal in efficiency to combined Lancashire boilers and economisers, and that when they are worked in conjunction with economisers (and all boilers, no matter what their design, should be fed with heated water) they give a proportionately higher efficiency under similar conditions of working; while the cost of installation, for fair-sized units, and for attendance, repairs and maintenance is no greater than for high-pressure Lancashire boilers. Dealing with the subject of mechanical firing, Mr. Constantine said: One of the most interesting forms of mechanical firing is that of introducing to the furnace, fuel which has previously been converted into powder, in such a manner as to secure the utmost combustion of the heat-giving constituents attainable in practice. After long experimenting and trial, a satisfactory system has been developed by means of which low-priced or unsaleable small fuel can be utilised with marked economy, as compared with the fuel usually employed in the generation of steam. This opens up a wide field for the using up of enormous quantities of what has hitherto been regarded as an unsaleable by-product of collieries and gas works. Mechanical draught is a branch in which, after many failures, great progress has been made; and when a system of artificial draught is devised, after an intelligent study of the conditions has demonstrated its desirability and practicability, satisfactory results have ensued from its employment.

On Saturday last Mr. W. C. Mountain delivered his third lecture on "Electricity as Applied to Mining," at Nottingham University College.

Cable Steamers.—The German telegraph steamer *Stephan*, belonging to the Norddeutsche Seekabelwerke, is reported to have sailed from Port Said for Nordenham on the 7th inst., and should reach her destination about the 19th. She will have been away four months all but five days. During this time she has steamed out to Shanghai, successfully laid the section of cable between there and the Island of Yap, in the West Caroline Group—a length of some 1,800 miles—coaled, returned to Shanghai, landed her spare cable, and finally steamed back to Nordenham, making a total distance of over 25,000 miles.

The steamer *Von Podbielski*, belonging to the same firm, has during this period been sold to the Dutch Government, for service as a repairing ship in the Dutch East Indies, and has been renamed the *Telegraaf*. After extensive alterations, to make her suitable for a tropical climate, she proceeded to the East loaded with a cable to be laid between Macassar and Balikpapin. This work has been duly accomplished, and the German-Dutch system of cables completed between Java and China, connecting at Guam with the Commercial Pacific Co.'s system.

The Complete Municipal Fault Finder. — Every municipality owning a fair sized network of mains, should possess on its electrical staff an individual specially trained in what might be called electric second sight, or the psychology of fault finding.

At ordinary times, when all is calm and bright, this super-man can be used to wash the shift engineer's collars, or wipe the perspiration from the stokers; but, anon, when the busiest part of the town is plunged into Stygian shadows owing to a cable breakdown on some Friday night, and the circumambient darkness rings with the curses of shopkeepers and the howlings of publicans and sinners for light—then does our noble faultfinder find his true vocation and enter with joy upon his labours. And the method thereof is something like this:—

Alone, in a quiet corner, with a plan of the mains fronting him, he gazes with soul enrapt and classic chin on hands into a glass (with a bit of lemon in it, perchance). After a few minutes of deep cogitation (and deeper draughts from the aforesaid pipkin) light breaks upon him, and he places his confident and grimy premier digit on the plan at the faulty place.

Out goes the mains man with jointer and handcart, and repairs the trouble at the spot indicated.

A man like this would be a boon and blessing beyond all the D'Arsonval or Kelvin test sets ever invented; saving time, trouble and mains men.

How many mains men have come to an early grave through falling downstairs when finding faults in their sleep, and how many are at this moment sojourning in padded rooms, smiling idiotically at the gas bracket and babbling incessantly of loop tests, earths on positives, and the foolishness of the 5-light pork, butcher in the Market Place?—Duplicator.

Appointments Vacant.—An electrical draughtsman is to be appointed at Hackney at a salary of £130 per annum; two shift engineers for Brighton electricity works (50s.).

The Railway Electric Power Scheme.—A powerful syndicate has been formed to promote a Bill in Parliament to carry out the electric power scheme, which has been already referred to in our columns, and which is generally known as the "St. Neot's" or "Railway" Power Scheme. A joint stock company has been registered with a capital of £60,000, to provide in the first instance the financial necessities of the enterprise during the passage of the Bill through Parliament, and the names of the members of the syndicate which appear on the register as signatories to the memorandum of association are a guarantee that any necessary capital will be forthcoming for the ultimate construction of the electric works and mains. The signatories to the memorandum of association are:—

Law Debenture Corporation, Ltd.	Messrs. Lazard Bros.
Railway Share Trust and Agency Co., Ltd.	Messrs. Helbert, Wagg & Russell
Mercantile Investment and General Trust Co., Ltd.	Messrs. Sperling & Co.
United States and South American Investment Trust, Ltd.	Col. Henry Platt, C.B.
Right Hon. G. J. Shaw Lefevre	Mr. Louis Floersheim
Right Hon. J. W. Mellor, K.C.	Mr. Robert Fleming
Sir James Sivewright, K.C.M.G.	Mr. J. G. B. Stone
Sir William Mather	Mr. George Kitchin
Sir John Gray Hill	Mr. J. S. Bergheim
Messrs. R. Raphael & Sons	Mr. H. A. Vernet
Messrs. Stern Bros.	Mr. Stanley Boulter
	Mr. E. B. Merriman
	Mr. G. A. Touch
	Mr. Joseph Beecham

The directors of the syndicate are stated by the articles of association to be Mr. Stanley Boulter (chairman), Mr. George Kitchin, and Mr. H. A. Vernet.

The objects of the Bill are the supply of electric energy in bulk to railways, Metropolitan Borough Councils, and existing electric supply companies. The promoters are, we understand, directing their attention mainly to the supply of the great London railways, for the electrification of whose suburban traffic it is estimated that fully 700,000,000 units per annum will in the near future be required; but negotiations are also pending for supplying in bulk municipal and other electric undertakings.

OUR PERSONAL COLUMN.

[The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.]*

Central Station Engineers.—The Woolwich B.C. has appointed the assistant electrical engineer (Mr. G. W. Keats) to be acting electrical engineer until the appointment of a successor to Mr. Mitchell. It was resolved to give a testimonial to Mr. Mitchell testifying to his capabilities as an electrical engineer.

The Canterbury T.C. has appointed Mr. S. B. Tite as switchboard attendant.

Mr. E. Crosse has been appointed mains assistant engineer to the Woolwich Borough electricity undertaking in place of Mr. C. W. Bloomfield, who has resigned to take up an appointment in the drawing office of the British Insulated and Helsby Cables, Ltd., of Prescot.

Mr. Harry Richardson, the electrical engineer for Dundee Corporation, is reported to have been offered an appointment in connection with a large electrical engineering firm in England.

The staff of the Barking U.D.C. Electricity and Tramway Works have presented Mr. A. H. Seabrook, the late electrical and tramways engineer, who has obtained a similar appointment at West Ham, with a marble clock with bronze reliefs.

Mr. Henry Wilkinson, of Radcliffe, has been appointed electrical engineer to the Radcliffe District Council. There were 157 applicants.

Tramway Officials.—The following increases of salary are to be given in connection with the tramways department of East Ham Town Council:—T. Owen, traffic superintendent, present salary £200, increased to £210; W. G. Newton, outdoor assistant, from £200 to £210; W. R. Elliott, station superintendent, present salary of £180 increased to £190; T. Aitken, mechanical engineer, present salary of £180 increased to £190; E. T. Baker, chief clerk, present salary of £140 increased to £150.

General.—The staff of the electrical department of the North Staffs Railway at Stoke-on-Trent have presented a kit bag to Mr. Reginald P. Bould, and he received from the superintendent (Mr. A. F. Rock) a writing case, on his departure to take up an appointment on the North-West India State Railways.

Mr. Percy P. Gutteridge, accountant to the Light Railways Committee of the Gloucester Corporation, has been appointed cashier and accountant to the Wakefield and District Light Railways Co.

Mr. Gilbert C. Vyle, A.M.I.E.E., has resigned his position as works manager and assistant to the general manager of the Telephone Department of the General Electric Co.'s Works at Salford, and has established himself at 14, Ridgefield, Manchester, as a consulting engineer for telephones and all systems of electric signalling. He is also specialising in works organisation and the

manufacturing details necessary for the economic production of light and intricate mechanical and electrical apparatus.

Mr. W. S. Halliwell, electrical engineer to the Colony of Lagos, is at present in this country, on leave. His address is Darcy Lever Old Hall, Darcy Lever, Bolton, Lancs.

Mr. H. C. Hawkins, who is retiring from the staff of the Arc Works, Chelmsford (Messrs. Crompton & Co.), has been presented by the staff and employés with a silver tray.

We learn that Mr. John Cowan has resigned the managing directorship of the Stirling Boiler Co., Ltd., of Motherwell, and 25, Victoria Street, Westminster. The directors have appointed Mr. E. G. Constantine, A.M.I.C.E., M.I.M.E., of Manchester, to be managing director, and he will enter upon his duties at Motherwell on January 1st next. Mr. Cowan still retains his interest in the company, and will continue to be chairman of the directors.

We learn that Mr. Bertram S. Giles, M.I.E.E., has been appointed by Messrs. Mather & Platt, Ltd., chief representative for London and the South of England for their electrical and hydraulic departments. Mr. Giles was previously employed for nearly 17 years by Messrs. Mather & Platt, Ltd., at their Salford Iron Works.

Obituary.—The death has occurred at East Acton of Mr. Ivon Molesworth Charles Jason de Havilland, A.I.E.E., who designed the "Iris" motor-car, concerning which much favourable comment was made at the Olympia Exhibition. Deceased, an electrical engineer, was only 27 years of age, and on Sunday evening last, after having been in bed a week ill with influenza, he procured a revolver, which he kept in readiness for burglars, and shot himself twice in the left breast, death being instantaneous.

A Dalziel Press telegram from Paris says that M. Arthur Radiguet, who devoted his life to the study of X-rays, particularly in regard to their effect on the human body, has just died in Paris, a victim to his devotion to the science. The X-rays produced a wound on his right arm which could not be healed. Gangrene eventually set in, and M. Radiguet succumbed.

NEW COMPANIES REGISTERED.

London and General Power Supply Co., Ltd. (86,791).—This company was registered on December 9th, with a capital of £60,000 in £10 shares, to carry on the business of generators, transmitters, distributors and suppliers of electrical energy for any purposes, constructors and equippers of generating stations and electric light and power works, layers of cables and wires, company promoters, financiers, &c., and to apply for any necessary Acts of Parliament or Orders. The subscribers are:—

	Shares.
H. R. Russell, South Sea House, Threadneedle Street, E.C., stockbroker	150
J. G. B. Stone, 9, Drapers Gardens, E.C., stockbroker	50
R. D'Oyley Carte, Savoy Hotel, W.C., gentleman	50
R. Fleming, 2, Princes Street, E.C., merchant	100
Lazard Bros. & Co., 40, Threadneedle Street, E.C., merchants	50
R. Raphael & Sons, 25, Throgmorton Street, E.C., merchants	100
Stern Bros., 6, Angel Court, E.C., merchants	100
The Right Hon. G. Shaw Lefevre, 18, Bryanston Square, W., Privy Councillor	25
Railway Share Trust and Agency Co., Ltd., 3, Bank Buildings, E.C.	50
L. Floersheim, 3, Bank Buildings, E.C., merchant	25
Sir J. G. Hill, Kt., 10, Water Street, Liverpool	25
The Right Hon. J. W. Mellor, 68, St. George's Square, S.W., Privy Councillor	10
E. B. Merriman, 39, Threadneedle Street, E.C., Chairman Capital and Counties Bank	10
H. Milton, 41, Threadneedle Street, E.C., secretary	50
Sir Wm. Mather, Kt., 16, Kensington Palace Gardens, W., engineer	50
H. H. Bartlett, 39, Victoria Street, S.W., contractor for public works	50
J. S. Bergheim, Belsize Court, Hampstead, N.W., gentleman	100
Sir H. Platt, C.B., Gorddinog, Llanfairfechan, Carnarvon	50
Sir James Sivewright, K.C.M.G., Tullyallan, Kincardine-on-Forth, Fife, landed proprietor	100
G. A. Touch, Basildon House, Moorgate Street, E.C., chartered accountant	50
J. E. Rawlins, J.P., Syston Court, Bristol, Chairman North Wales Power and Traction Co., Ltd.	50
Joseph Beecham, St. Helens, Lancashire, merchant	50
E. Welton and J. W. Strange, Bond Court, Walbrook, E.C., stockbrokers (members of the firm of Sperling & Co.)	100

No initial public issue. The number of directors is not to be less than two nor more than seven; the first are Stanley C. Boulter (chairman), Geo. Kitchin and Henry A. Vernet, with power to add to their number; qualification, £500; remuneration, 5 per cent. of the profits available for distribution to the members, divisible.

CITY NOTES.

India-Rubber, Gutta-Percha and Telegraph Works Co.

The directors' report for the year ending September 30th, 1905, to be presented at the meeting at 106, Cannon Street, E.C., on Tuesday, December 19th, shows, after provision for doubtful debts, a net profit of £51,729. Adding £53,274 brought forward, and deducting £12,500 interim dividend paid in June, there remains a disposable balance of £92,503. The directors recommend the distribution of a dividend of 15s. a share, free of income-tax, amounting to £37,500, making, with the interim dividend paid in June, a total payment of 10 per cent. for the year, and leaving £55,003 to be carried forward. The general business of the company shows an increase compared with last year, and although the price of raw material is still very high, the fluctuations have not been great, and therefore better prices have been obtained for manufactured goods. The cable department, besides having other smaller work in hand, is at present engaged in the manufacture of 1,300 nautical miles of submarine telegraph cable, which will be laid by the company's cable steamer *Silvertown* between Shanghai and Manilla in March next. The *Dacia* and *Buccaneer* have been employed in cable-repairing work during the year, and the latter is at present under charter. The works at Silvertown and Persan have been maintained in their usual state of efficiency, but considerable expenditure must still be made at Persan to provide for the economical production of goods for the French market. The board regrets to record the death of Mr. Stephen William Silver, one of the founders of the company, who to the last took the deepest interest in its welfare. His advice and guidance were always, as the shareholders know, of the highest value, and, although he has passed away in the fullness of years, his loss is none the less great. The Board also regrets to record the death of Mr. John Bailey, who had recently retired from the position of manager at Silvertown. Mr. Bailey served the company since 1864, and earned the esteem and respect of all with whom he was thrown in contact. The Hon. Henry Marsham, owing to the necessity of residence abroad during a considerable portion of the year, has resigned his position as a director, and has been appointed an extraordinary director. Major Leonard Darwin has been elected chairman. Mr. George Henderson and Major Leonard Darwin, the retiring directors, offer themselves for re-election.

Aron Electricity Meter, Ltd.

Mr. H. Hirst presided at the meeting held at Winchester House last Friday. He said that the report (see Electrical Review, December 8th) was not yet quite the subject of congratulation to the shareholders; they were not yet paying the full 6 per cent., but the directors had the right to be pleased with it to a certain extent. The path they had entered upon was beginning to look straight and clear. They had practically earned sufficient this year to pay the full 6 per cent., but they would like to have another year's results before them before they resumed that rate. It was only the consideration of the best interests of the company that had prevailed upon them to declare 4½ per cent. dividend. He proceeded to make comments upon such figures in the balance-sheet as were different from last year's. The loss carried forward from recent years had disappeared. The stock of meters, clocks and parts was £6,000 up for two reasons. First, they had done an increased business, which naturally meant a little larger stock. The other reason was that the stock had increased, particularly in their German business, and in view of the serious labour troubles in Germany, Prof. Aron, not knowing which industry might next be affected—he was drawing his supplies from various industries—thought it wise, so that they should not suffer more than necessary, to fill up his stocks to the best of his ability. It was all good stock. In regard to the profit and loss account, they had always been very liberal in depreciation, and that item was again very large. It strengthened the company to be liberal in that way. Upon the maintenance of patents they had spent over £1,000 more. The meter business, as well as the electrical business generally, was in a constant state of evolution, and it would be no use sitting tight on their patents if they did not employ a constant staff and try to get ahead of what other makers were doing. They hoped one day to get ahead of them all, so this item was a necessary expense. They had not altered the item of goodwill in the balance-sheet for this reason. The results of that fairly satisfactory report were due principally to the business carried on in Germany and at their branch in Vienna. In Germany Prof. Aron had worked very hard and economically, and had used his influence even to the extent of obtaining orders by travelling a great deal himself. In France and England they could not claim to have made any profit—they had even made a small loss. The reason for this was a different one in each country. In France they used to do their business principally with the central stations in Paris; recently they had to make efforts to do business in the country with the smaller stations. Paris was stagnant at present, because the concessions of the electric lighting companies expired in 1907. The State had not yet settled the policy that was to be carried on after 1907. The companies, feeling that they might have to lose all their rights and to clear out without adequate compensation, were not following other companies and reducing their prices, and they had shirked capital expenditure and everything that meant buying. Until it was settled which way the future supply was to be carried on, not much business might be expected from Paris. The meter enjoyed a good reputation there, and as the question had to be settled in 1907, they had thought it wise, with the smallest amount of expenditure, to carry on their business until they knew what the future had in store for them. It might surprise them when he said that there was more private house electric lighting in this country than in any other. Production of electric lighting here appeared to be much cheaper than in Germany and on the Continent generally, and when a commodity was cheap, engineers were not so careful with it as when it was dear; in other words, their meter, which was the most accurate one, was not so much appreciated to measure a cheap commodity where the unit cost 1d. or 2d. or 3d., as it was to measure an expensive commodity in Berlin or Vienna, where it was 6d., 7d. or 8d. In consequence, the craze had been for cheap meters. The company had spent a lot of money to produce cheap meters, and he was exceedingly pleased that their little meter was finding favour, but it had not yet found favour in such quantities as would help the company seriously in its dividends, though they had reason to hope. The business that had generally been done in this country had been for two-rate, or double-tariff meters, and for standard instruments and traction meters. Some railway and traction companies had begun to appreciate the use of putting meters on their

engines and cars in order to check the drivers against each other. If that measure took popular favour, he believed their meter would one day give satisfaction. Whilst formerly the company practically supplied one type of meter, the money they had spent year after year in maintenance of patents and developments had put them already on a little broader base. In that direction they wished to continue, and they were at present studying petrol traction and auto-car developments for the purpose of seeing whether they could not find an outlet for their unemployed capital. They hoped next year, if they had good results, to put some tangible proposal before them. After paying a personal tribute to Dr. Aron, he formally moved the adoption of the report.

Sir J. Pender seconded, and after some discussion it was carried unanimously.

A Shareholder was of opinion that the full preference dividend should have been paid, and a smaller balance be carried forward. There was nothing more disastrous to existing or future prosperity than for the preference interest to be in arrears.

The Chairman said that if they had paid the 6 per cent., there would be, under the agreement, commission due to Dr. Aron; there also would be directors' fees to pay, and the amount carried forward would have dwindled down.

The retiring directors and auditors were re-elected.

Isle of Thanet Electric Tramways and Lighting Co.

The report for the year ended September 30th last states that traffic receipts show a reduction of £2,924, and the sale of electricity an increase of £490. The directors regret that the profits have only enabled them to pay the preference dividend to March 1st, 1905, and they have carried forward the balance of revenue, £1,047. Two accidents took place during the year. The company was fully insured against third party risks, and therefore lost nothing by personal claims, but the accidents had a detrimental effect on the traffic receipts. An inquiry was held by Col. Von Donop, R.E., on behalf of the Board of Trade, into the accident which occurred on Madeira Hill, and the report of the inquiry has just been issued. Col. Von Donop attributes the accident to want of experience on the part of the driver. Owing to the greatly increased service of cars required for a few months during the summer, it is necessary that a number of new drivers should be employed every year, but they are trained as thoroughly as possible before they are placed in charge of cars. The company have, however, now made arrangements for exchanging drivers before arriving at Madeira Hill and the other steep gradients, so that in future none but their most experienced men will operate the cars on these parts of the system. The sum of £418, being the cost incurred in the unsuccessful promotion of a lighting order for Ramsgate, has been charged against revenue.

British Electric Traction Co.

The interim report states that since the date of the last report about 17½ miles of new or reconstructed tramways or light railways have been opened for traffic by electric traction, and the Bombay horse tramways, of about 17 miles, have been added to the list of associated undertakings. The total mileage of tramways, railways, and combined omnibus routes is now 439 miles, and the total traffic receipts of all the associated undertakings for the current year are estimated at £1,400,000, as compared with £1,264,061 for 1904. Electrical lines are now under construction at Penge and Croydon to Mitcham, near London, at Cavehill, near Belfast, in Middlesex (forming part of the large system of the Metropolitan Electric Tramways Co.) and in the Birmingham district. In spite of the fact that the company had sold its interests in several undertakings to local authorities and others, upon which the return for 1904 was about £12,000, the directors expect that the aggregate return for the current year upon the company's investments will be maintained. The directors anticipate that satisfactory profits will be made by the company before the closing of the books on March 31st next, but, as the substantial profit receivable in shares of the Bombay Electric Supply and Tramways Co. has not actually been received at this date, the directors prefer not to declare an interim dividend on the ordinary shares for the present half-year. The Bombay Co. has successfully raised £600,000 in debenture stock and £600,000 in 6 per cent. preference shares, thus enabling this company to meet its main obligations in regard to this enterprise. Energetic steps are being taken to carry out the conversion of the tramways to electric traction, and to enable the Bombay company to deal effectively with the supply of electric light and power, for which there will be a large demand. The volume of business carried out by the Brush Electrical Engineering Co. during the current year shows a considerable increase. The rolling stock and general engineering departments are expected to show improved returns, but owing to keen competition the margin of profit upon the manufacture of electrical machinery is small. The Brush Co. is largely interested in the tube railway authorised by Parliament to be constructed from the Marble Arch along the Edgware Road, but considerable uncertainty has prevailed in regard to the traffic question in London, pending the issue of the report of the Royal Commission. In the meantime the construction has not been proceeded with. A further Bill will be promoted in the ensuing Session, for which notice has been given, for an extension of time for construction, and also to authorise, as recommended by the Royal Commission, the construction of an underground railway from the Marble Arch to Victoria, forming an extension of the authorised Edgware Road tube railway.

British Westinghouse Electric & Manufacturing Co

The sixth annual report of the directors for the year ended July 31st, 1905, states that the profit and loss account shows a gross profit of £113,409 7s. After providing for debenture and loan interest, depreciation and the further special expenditure enumerated below, the directors regret that a loss of £15,407 10s. 10d. is shown after deducting the balance of £2,809 15s. 11d. brought forward from last year. The special items are:—

Exceptional expenditure under the Mersey Railway contract	£43,549 17 1
The balance of exhibition and sundry expenditures brought forward on July 31st, 1904, now written off	£5,340 2 1
Proportion applicable to the current year of excess cost and experimental expenditure on manufacture of new types of apparatus during that period	£25,000 0 0

"Following the course indicated by your directors in last year's report, care has been exercised to have your works' equipment efficiently maintained, and, in addition, a very considerable sum has been charged to profit and loss account for the maintenance of large machine tools and machinery, while all patterns and drawings, together with patents acquired, have equally been charged to profit and loss account. In view of this, your directors are of opinion that the sum of £16,500 provided for depreciation, which includes £5,000 in respect of the buildings themselves, is adequate.

"The balance of £225,000 of 4 per cent. mortgage debenture stock available for issue has been sold to the American Westinghouse Co., to be taken at 95 per cent., in the course of the year 1906.

"The volume of the output from the works during the year under review was considerably in excess of that for the previous year, and a large saving in manufacturing costs and in selling and general expenses was effected. Competition is still very keen, and seriously affects the company's business and outlook; but it is hoped by the directors that with the revival in trade this condition may improve.

"Mr. J. W. Cloud and Sir Joseph Lawrence, M.P., have retired from the board, and Mr. Newcomb Carlton, a vice-president of the Westinghouse Electric and Manufacturing Co., of Pittsburg, Pa., U.S.A., was elected a director last month. This appointment will be submitted for confirmation at the meeting."

Lieut.-Col. Montagu Cradock, C.B., offers himself for re-election.

Prospectuses.

British, Foreign and Colonial Automatic Light Controlling Co., Ltd.—The list opened on Tuesday, and closes to-morrow, in an issue of 35,000 6 per cent. participating preference shares of £1 each. The company takes over the goodwill of the business of the Automatic Light Controlling Co., Ltd., and the patent rights of Mr. John Gunning for lighting and extinguishing gas lamps at predetermined times, and for improvements for opening and closing electric circuits at predetermined times. Current contracts for sale and hire of lamp controllers will also be taken over from the vendor company. The electrical switch is stated in the prospectus to have a great future before it and to be available for both public and private lighting and for illuminated advertisements. The purchase price is £50,000, as to £20,000 in cash, or part in cash and part in preference shares, and £30,000 in ordinary shares.

The Liberian Rubber Corporation, Ltd.—An issue of 120,000 shares of £1 each has been offered for subscription this week. The nominal capital is £270,000. The company acquires from the Monrovian Rubber Co. a Liberian Government concession for collecting and exporting rubber from that Republic. There are four rubber collecting stations at Bopora, Kaka, Sikong and Putu. There are stated to be 20,000 sq. miles of dense virgin rubber forest. Sir H. H. Johnston considers that the stations can be increased to 30, and the output of rubber to about 500 tons a year, yielding a net profit of about £65,000 per annum. Out of the present issue, £50,000 is to be provided for additional working capital. The concession is for 26 years. The Dunlop Rubber Co. has contracted with the company to purchase for 10 years at market price, less brokerage, its entire output of rubber. The list was to close on Wednesday.

Rubber Estates of Ceylon, Ltd.—This prospectus, too, has been before the investor, the list closing yesterday, with an issue of 40,000 ordinary shares of £1 each; 42,000 have been already issued. The company is to acquire, develop and work properties in Ceylon, suitable for the cultivation of rubber. The company is now producing tea, cocoa and coco-nuts, and during the development of the rubber it is estimated that sufficient profits should be earned to provide a small dividend, to be materially increased as rubber trees arrive at a productive stage.

British Columbia Electric Railway Co.—The issue of 185,000 5 per cent. cumulative perpetual preference shares of £1 each was considerably over-subscribed, and letters of allotment and regret have been posted.

Electric and General Investment Co. — The directors have declared interim dividends at the rate of 6 per cent. per annum on the preference shares for the six months ending the 31st inst., being 3s. per share, and at the rate of 10 per cent. per annum on the capital paid up on the ordinary shares, being 1s. per share for the six months ended the 30th ult. Both dividends will be paid, less income-tax, on January 1st, 1906.

Eastern Extension, Australasia and China Telegraph Co.—The directors have declared an interim dividend for the quarter ended September 30th of 2s. 6d. per share, free of income-tax.

Eastern Telegraph Co.—The directors have declared an interim dividend of 1½ per cent. on the ordinary stock in respect of the quarter ended September 30th, 1905.

MARKET QUOTATIONS.

Wednesday, December 13th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	82/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	£3 inc.
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	10d.	..
a ,, (50 %)	per gal.	9½d.	..
a Copper Sulphate	per ton	£22 10	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	190/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a Sodium Bichromate, casks	per lb.	2½d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£150	..
b ,, Wire, in ton lots	per ton	£177	..
b ,, Sheet, in ton lots	per ton	£175	..
b Babbitt's metal ingots	per ton	£48 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	8¼d.	¼d. inc.
c ,, Tube (brazed)	per lb.	10½d.	¼d. inc.
c ,, ,, (solid drawn)	per lb.	9¼d.	¼d. inc.
c ,, Wire, basis	per lb.	8¾d.	¼d. inc.
c Copper Tubes (brazed)	per lb.	11¾d.	¼d. inc.
c ,, ,, (solid drawn)	per lb.	11¾d.	¼d. inc.
g Copper Bars (best selected)	per ton	£95	£4 inc.
g Copper Sheet	per ton	£95	£4 inc.
g ,, Rod	per ton	£95	£4 inc.
e ,, (Electrolytic) Bars	per ton	£88	£6 inc.
e ,, ,, Sheets	per ton	£100	£5 inc.
e ,, ,, Rod	per ton	£92 10	£6 inc.
e ,, ,, H.C. Wire	per lb.	10¾d.	¼d. inc.
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/7	1d. inc.
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/2 to 5/8	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	53/3	4d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£17 10 to £17 12 6	25/- inc.
g ,, ,, Sheet	per ton	£19 7 6	25/- inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 5	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/8	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/8	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	85/6	1/6 inc.
e Silicium Bronze Wire	per lb.	11d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£165 10 to £166 10	£6 10 inc.
n ,, Wire, Nos. 1 to 16	per lb.	1/10½	½d. inc.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£46 to £70	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4½d.	..
j ,, 10 lbs. Russian, single	per lb.	4¾d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£31 15	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Glover's Almanac.—Messrs. W. T. Glover & Co., Ltd., of Trafford Park, have once more placed many an electrical engineer and office worker under a debt of gratitude, they having just issued their 1906 Almanac. It takes the same form as before, to which we have all become well accustomed by now, being made up of a block of daily tear-off slips, with matter of electrical interest on each—sometimes quotations from Institution speeches or papers, at others versification, while yet others are simply illustrations. The appearance of Glover's Almanac is one of the looked-for events of the electrical year, and the 1906 one will be as acceptable as its predecessors.

STOCKS AND SHARES.

Wednesday evening.

Money conditions remaining easier, Stock Exchange markets are, on the whole, steady to good. In some few speciality sections a fair amount of business is being transacted; but, on the whole, the approach of Christmas tends to check new trade. The political ferment causes remarkably little practical effect upon prices, so that the City comment on the new Cabinet may be taken as favourable.

Electrical departments, of course, have the slump in British Electric Traction and British Westinghouse Preference shares as their outstanding feature. The latter fell to 2 upon a disastrous report, that is reprinted elsewhere. British Electric Traction Ordinary collapsed from 10 to 8½, when it was announced that no interim dividend would be paid. A further fall to-day (Wednesday) makes the price 8, while the Preference have dropped to 10½, and both the Debentures are lower.

In view of the dramatic falls in the above shares, a few particulars are worth noticing in reference to the highest and lowest prices reached during the last five years, with the dividend record added:—

Company.	1901.	1902.	1903.	1904.	1905.
B.E. Traction Ordinary	16½—12½	15—12	14½—11½	11⅝—8	10½—8⅛
British Westinghouse Pref.	4¼—5½	6¼—5¼	6⅝—4¼	4⅜—2⅝	3¾—1⅞

For 1901 and 1902 British Electric Traction Ordinary received 9 per cent., while 8 per cent. was paid in 1903, and 6 per cent. in 1904. The last distribution was one of 6s. per share in July, 1905. Westinghouse Preference got their full 6 per cent. until 1904, when the proprietors received only 3 per cent. in the February of that year, and nothing has been paid since. Those who have followed these notes will have been prepared for the non-appearance of a dividend on Westinghouse Preference now, but the gloomy nature of the report had hardly been anticipated, and as for the passing of the interim dividend on British Electric Traction Ordinary, this was entirely unexpected. Insiders were steadily selling a little while ago, but not in sufficient amount to cause any suspicion as to the actual state of affairs. The reason given for this passing of the dividend is that "the substantial profit *receivable in shares* of the Bombay Electric Supply and Tramways Co. has not been actually received at this date." The italics are our own, and a more flimsy pretext for not declaring a dividend it would be difficult to conceive. The market is busily speculating as to the real reason for this step.

Brush shares are unchanged, despite the traction slump. Indeed, the company's two Debenture stocks have substantially improved, following upon the advance of last week. On the other hand, Willans & Robinson dropped 2 to 84½, on pressure of sales, and Westinghouse Debenture shed five points to 82½. Manufacturing shares on balance show a harder tone. India-Rubber, Gutta-Percha shares shot up to 19, a rise of 50s., upon the company's resumption of 10 per cent. dividends, the lately issued report being exceedingly good. Telegraph Constructions rose 10s. in sympathy, but dropped back again to 33. Edison & Swan "A" fully-paid shares at 2½ are 5s better.

Telegraph descriptions display insignificant movements. Even Eastern Extensions have not moved, despite the recent success of the company in its Australian negotiations. The Preference stock, however, hardened a shade to 91. Dulness continues to depress West African Telegraph shares, and Reuter's are ¼ lower at 7½. While Great Northern Telegraphs put on 1 at 37, notwithstanding the Russian riots, Indo-Europeans lost 10s. at 58. Direct United States are well maintained at 14½, but Anglo-American stocks went a shade easier, excepting the Deferred. The only change in Telephones is ⅛ rise in United River Plate Preference, which are 5⅝ middle.

No change for the better has occurred in the Electricity Supply list. The falls this week embrace County of London Ordinary, Metropolitan Preference, St. James's Ordinary and South London shares. Hove Ordinary are nominally better at 8½, and the weakness of the metropolitan companies' shares would appear to have added strength to provincial issues.

For British Columbia Railway Electric Railway Preferred and Deferred stocks to have declined somewhat suddenly is not a surprising sequel to the issue of new Preference shares; some shareholders have perhaps exchanged the old for the new. Argentine varieties have hardly altered, and London United Tramway Preference are 10¼.

Metropolitan Railway Consolidated is still weak at 87½, and Districts also went flat to 36½, both falls being due in part to another reduction in fares that takes place this week. The drop in Metropolitan was humorously ascribed by one grave financial authority to sales on behalf of a "diseased account!" City and South London is rather off at 46, and for some occult reason the market says that the Charing Cross accident may imbue the public with suspicion of tube stocks because of the suggestion that underground burrowing will render London a more risky place to live in than ever. But Baker Street and Waterloo Debenture is 102, Great Northern, Piccadilly and Brompton certificates 98½, and Charing Cross, Euston and Hampstead 97½—all being 4 per cent. stocks. That Underground Electric 5 per cent. profit-notes stand at a point or two below par is because of the finance of the group of companies with which this one is associated.

London Motor-Omnibus shares have weakened to 2, and District Motors and 'Bus to 1 7/16, while the premium on the new Motor-'Bus shares fell to half-a-crown. Contrariwise, the issues of the London General Omnibus and the Road Car Companies are both better.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905. §	Closing Quotations Dec. 6th.	Closing Quotations Dec. 13th.	Business done week ended Dec. 13th, 1905. Highest	Lowest.	Rise + or Fall —
84,800	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	99 —102	99—102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¾— 4¼	3¾— 4¼	..	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	85 — 90	85 — 90	..	..	..
763,580	Anglo-American Telegraph	Stock	60/6	61s.	2⅝%	29s.§	62 — 64	61 — 63	61½	..	—1
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝%	58s.§	109¼—110¼	109 —110	110	109	— ½
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	..	17⅛— 17⅝	17¼— 17⅝	17⅝	17	..
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	102 —104	102 —104	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅞— 7⅞	7⅞— 7⅞	..	..	..
1,982.856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 98	96 — 98	97⅞	96¼	..
16,000	Cuba Telegraph	10	6½%	10 %	5 %	5 %§	8½ - 9½	8½— 9½	8⅝	8½	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %§	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %§	3⅜— 3⅝	3⅜— 3⅝	3⅜	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %§	9¼ — 9¾	9 — 9¼	..	..	— ¼
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%§	100 —103 %	100 —103	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	3 %§	13¾— 14¼	14 — 15	14½	12⅝	+ ½
74,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	100¾—102½	100¾—102½	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 %§	144 —147	144 —147	146⅝	144	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%§	89⅜ — 91½	90 — 92	91½	90⅜	+ ½
1,836,814	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %§	106 —108	106 —108	107½	106½	..
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 %§	14½— 15	14½— 15	14⅝	..	..
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %§	106 —108	106 —108	107½	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101½	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	£3	5⅛%	5⅜%	5⅜%	5 %	10½— 10⅝	10½— 10⅝	10⅝	10½	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅛— 14⅜	14⅛— 14⅜	14⅜	14⅛	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	35 — 37	36 — 38	37⅜	36⅛	+1
46,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	5 %	57⅛— 59⅛	57 — 59	58	57½	— ½
251,127	Marconi's Wireless Telegraph	1	..	..	..	..	1⅛— 1⅜	1⅛— 1⅜	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	⅛— 1	⅛— 1	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅛— 1	⅛— 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %§	110½—111½	110½—111¼	111¼	110½	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %§	108 —110	108 —110	108⅞	108½	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %§	13 — 15	13 — 15	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %§	11 — 13	11 — 13	12½	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %§	5⅜— 5⅞	5⅜— 5⅞	5⅜	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	99½	98⅜	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	104 —106	104 —106	105⅛	104⅛	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	6 %	1⅛— 1⅜	1⅛— 1⅜	1⅛	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅜— 1⅞	1⅜— 1⅞	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	100 —103	97 — 99	..	..	—3½
11,889£	Reuter's	8	5 %	5 %	5 %	5 %§	7⅛— 8	7⅛— 7⅜	..	..	—¼
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	102 —105	102 —105	..	..	..
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	125 —128	125—128	..	..	..
58,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7⅛— 8	7⅛— 8	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	+ ⅛
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	111 —113	111 —113	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜— 10¼ xd	9½— 10 xd	10	9⅜	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/8	1/16	1/16	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100½—102½	101¼	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14 — 14½	14 — 14½	14⅜	14⅛	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅛— ¼	⅛— ¼	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8⅛— 8½	8⅛— 8½	8⅛	8⅛	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6⅛— 7⅛	6⅛— 7⅛	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

850,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	6 %§	8⅛— 8⅜	8⅛— 8⅜	8⅜	8 3/32	..
1,300,035	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝— 6⅛	5⅝— 6⅛	6 3/32	6	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	142 —145	142 —145	144¾	..	..
200,000	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	105 —107	105 —107	..	..	..
530,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	16 %§	3¾— 4	3¾— 4	3 23/32	..	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..
40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	3/6	5 — 5¼ xd	5 — 5¼	5⅛	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	3/-	4⅜— 5¼ xd	4⅜— 5¼	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2¼— 3¼	2¼— 3¼	..	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	98 —102	98 —102	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock ..	100	..	6 %	6 %	..	124 —127	121 —124	123	122	—3
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	111 —114 xd	109 —113	110	109½	—1½
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	106 —109	106 —109	107¾	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105 %	103 —105%	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	9⅛— 10⅛	7⅛— 8⅛	9⅛	7⅞	—2
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	11 — 11⅜	10 — 11	11⅝	10⅝	— ⅜
1,000,000£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	121 —123	119 —121	121¼	120	—2
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	98 — 100	97 — 99	98⅛	97⅛	—1
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %§	6⅞— 7	6⅞— 7	6 23/32	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %§	5⅞— 6⅛	5⅞— 6⅛	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%§	103 —106	103 —106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	98 —100	98 —100	..	..	..
2,000,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	2⅛— 2⅝	1⅞— 2⅛	2⅛	2	—1/16
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	85 — 89	80 — 85	..	..	—4½
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/8	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	½	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1½— 2	1½— 2	1½	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	94 — 98	96 —100	..	..	+2
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	80 — 83	84 — 86	..	..	+3½
500,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	..	3⅜— 3⅝	3⅜— 3⅝	3¾	3	..
200,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	..	5⅛— 5⅛	5⅛— 5⅛	..	..	..
197,500	Do. "B" do. 1 to 27,500	5	..	6 %	6 %	..	5⅞— 6⅛	5 — 5¼	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	107 —109	107 —109	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	104¼	..	..
525,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	7 %§	9¼— 9¾	9¼— 9¾	9¼	..	..
163,050	Do. 105,001to 137,610	5	..	..	..	3d.	8⅝— 9	8⅝— 9	..	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4 %	4½%	107 —109	107 —109	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	11 — 12	11 — 12	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅝— 5⅞	5⅝— 5⅞	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	109 —111	109 —111	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅞— 1⅛	⅞— 1⅛	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	..	..	..	1 — 1⅛	1 — 1⅛	1⅛	1⅛	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %§	93 — 95	93 — 95	94	93	..
523,396	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %§	101 —103	101 —103	102⅜	101½	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	..	85 — 88	85 — 88	87⅛	87	..
1,330,000	City and South London Railway	Stock	3⅛%	2⅝%	2⅝%	2 %§	45 — 48	45 — 47	46⅜	45	— ⅜
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	2½%	..	1⅝— 2⅛	2 — 2⅛	..	..	+ ⅛
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	94 — 99%	97 —100%	99	..	+2

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	§1905.	Closing Quotations Dec. 6th.	Closing Quotations Dec. 13th.	Business done week ended Dec. 13th, 1905. Highest	Lowest.	Rise + or Fall−
260,000	Dick, Kerr & Co., 1 to 52,000	† 5	..	..	10 %	..	8½ — 9	8½ — 9	8⅝	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 61,000	5	..	6 %	6 %	6 %	5⅞ — 6¼	5⅞ — 6¼	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	..	..	..
600,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	3 %	13¼— 14½	13¼— 14½	..	..	..
599,700	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14¼— 15½	14¼— 15½	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99¼—100½	99¼—100½	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	98 — 99	98 — 99	..	..	..
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	96 — 97	96 — 97	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½%§	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½%§	..	2 — 2¼	2⅛ — 2⅜	..	..	+ ⅛
844,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 90	85 — 90	85	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	92 — 97	92 — 97	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅛ — ⅜	⅛ — ⅜	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9¼ — 9⅝	9¼ — 9⅞	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	96 —100	96 —100	..	..	..
780,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %§	5 — 5⅛	5 — 5⅛	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10¾ — 11½	10⅝ — 11½	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —104	102 —104	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%§	12⅛ — 13⅛	12⅛ — 13⅛	13 3/16	12 13/16	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	.. — ..	.. — ..	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10 %	5 %	2½%§	16 — 17	18⅝ — 19⅛	19	18½	+2½
800,000	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1⅜%	1½%	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6¼ — 6⅝	6¼ — 6⅝	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	4 %§	10 — 11	9 — 11	..	..	− ½
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	4 %§	4 — 5	4 — 5	..	..	..
1,125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	10 — 10⅛	10 — 10⅛	10 1/16	10⅛	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	100 — 103	100 —103	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	3/32 — 5/32	3/32 — 5/32	1/8	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1— 1 1/16	1 — 1 1/16	1 1/32	1	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	106—108	106 —108	107½	..	..
160,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..
240,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	..	8⅝ — 9¼	8⅝ — 9¼	..	..	..
240,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	9¾ — 10¼	9¾ — 10¼	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	101 — 104	101 —104	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	10 %	32 — 34	32 — 34	33½	32½	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	97 — 98 xd	97 — 98 xd	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3 %§	94 — 97	94 — 97	..	..	..
333,330	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8⅓%	6 %§	..	..	1⅛ — 2	1⅛ — 2	..	..	..
333,330	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	..	..	2⅛ — 3⅛	2⅛ — 3⅛	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	84 — 89 xd	82 — 87	84	..	−2

ELECTRICITY SUPPLY COMPANIES.

70,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 %§	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	9 %	9 — 10	9 — 10	9½	9⅜	..
29,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	9 — 9¼	9 — 9¼	..	..	..
10,782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105 xd	102 —105	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %§	5⅜ — 6⅜	5⅜ — 6¼	6 1/16	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4⅜ — 5	4⅜ — 5	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	4⅜ — 5	4⅜ — 5	..	..	..
350,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	103 —105	103 —105	..	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	4½%§	5 — 6	5 — 6	..	..	..
150,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%§	110 —112	110 —112	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	5 %	11¼ — 12¼	11 — 12	..	..	− ½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13¼ — 14¼	13¼ — 14¼	..	..	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	124 —128	124 —128	126	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	103 —106	103 —105	104	103½	− ½
40,000	County of Durham Electrical Power, Ord.	2	..	..	..	..	2⅛ — 2 5/16	2⅛ — 2 5/16	..	..	..
50,000	Do. do. do. 5 % Pref.	5	..	..	..	..	5¼ — 5⅜	5¼ — 5⅜	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	4 %§	8¾ — 9⅛	8⅝ — 9⅛	9 1/16	9	− ¼
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	12⅝ — 12⅞	12⅝ — 12⅞	..	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	112 —115	112 —115	..	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..
70,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	..	5¼ — 5⅜	5⅛ — 5⅜	..	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..
300,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	108 —110	107 — 109	107½	..	−1
50,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	4 %§	5¼ — 5⅜	5¼ — 5⅜	5 1/16	5⅛	..
50,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	6	..	..
50,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
65,000	Hove, 1 to 13,000	5	..	8½%	8½%	8 %	8¼ — 8½	8¼ — 8⅝	..	..	+ ⅛
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	8 %	5¼ — 6⅛	6 — 7	..	..	+ ½
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —100	98 —100	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12 %	12 %	10 %	10¾ — 11⅜	10⅞ — 11⅜	..	..	..
136,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..
371,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %§	9¼ — 10⅛	9¼ — 10⅛	9⅜	9¼	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅝	5⅛ — 5⅝	5⅜	5	− ⅛
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	97 — 99	97 — 99	97⅛	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103 %	101 —103%	102⅛	..	..
285,045	Newcastle-on-Tyne, 1 to 57,009	5	..	8 %	8 %	2½%§	8 — 8¼	8 — 8¼	..	..	..
89,955	Do. 57,010 to 75,000	5	..	..	..	2¼%	8 — 8¼	8 — 8¼	..	..	..
285,045	Do. 5 % Pref., 1 to 57,009	5	..	5%	5	5 %	6¼ — 6⅜	6¼ — 6⅜	..	..	..
89,955	Do. 57,010 to 75,000	5	..	..	..	2¼%	6¼ — 6⅜	6¼ — 6⅜	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	6 %	14½ — 15½	14½ — 15½	..	..	..
59,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..
92,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6¾%	7 %	5 %§	6⅝ — 6¾	6⅝ — 6⅞	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	100 —102	100 —102	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	10%§	13 — 14	12⅞ — 13⅜	13½	13	− ½
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %§	8 — 9	8 — 9	..	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	98 —100	98 —100	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	..	2 — 2½	2 — 2½	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	13%	3 %	4 %	..	3⅛ — 3⅜	3 — 3⅛	3 1/16	3⅛	− ⅛
100,000	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	1/16	..	..
50,000	*(Late Blackheath and Greenwich* (7 % Pref.	1	Nil	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
100,000	*Dist. E.L.Co.)* (4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..
30,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4¼ — 4⅜	4¼ — 4⅜	..	..	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5 — 5¼	5 — 5¼	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	104 —106	104 —106	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13⅓%	14 %	13 %§	11¼ — 12¼	11¼ — 12¼	12¼	11 1/16	..
28,151	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5¼ — 6¼	5⅞ — 6¼	..	..	..

Shares not officially quoted :—Mackay Companies, ord., 52½—53½. Pref. 74—75.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent. (September 28th, 1905).

ELECTRIC CARS AT OLYMPIA.

[COMMUNICATED.]

(*Concluded from page* 917.)

Messrs. Henry F. Joel & Co., of 31, Wilson Street, Finsbury Square, London, E.C., who have had a very long experience in building and running electric carriages exhibited a very elegant little carriage on the stand of Hora Co., Ltd. There were several new and interesting points in this carriage. It was the only light electric carriage exhibited, weighing 17 cwt. complete with battery, motor, &c.

Fig. 5.—Joel Electric Park Phaeton.

The carriage will seat two at the back, with an additional seat in front, and will run 50 miles with one charge, carrying two persons, at speeds from 4 to 20 miles an hour. It is designed on the latest French model, and has a weather hood and leather wings. It is built on a steel chassis, and is finished in the very best style, being upholstered in best leather. The wheels are all of the same size, with artillery hubs and pneumatic tires.

The control and steering are so simple that a lady can easily manage and drive the car, whilst the comfort, freedom from vibration and smell, and smoothness of running make it an ideal carriage.

The electric motor (Zone patent), of 4 to 6 h.p., has the very high efficiency of 87 per cent., and is of extremely light weight (only 200 lb.). The motor has a double-wound armature with two commutators. This is suspended on a tubular underframe independently of the carriage body, and this underframe, with the motor and gears, can be easily detached and lowered on the ground for inspection, cleaning, &c.

Fig. 6 shows the plan of the chassis made by the Joel Co., with the motor, gears, &c., and fig. 7 is a plan of the motor and gears with suspension tubes detached, while a side view of the chassis is given in fig. 8.

The motor drives the back wheels by means of a chain and balance gear. The underframe connects the front and back wheels by means of a spring support on the front axle, and adjustable screw connectors on the back axle, which allow the chain to be tightened as desired.

The motor and chain drive is admitted by all authorities to give the highest possible efficiency, whilst it allows of perfect flexibility.

Every part, motor, gears, &c., can be easily seen for oiling, &c., through traps in the footboard.

The battery to run 50 miles consists of 42 cells, weighing 7 cwt., and is divided into seven portable trays, which are easily handled for inspection.

A special feature of this battery is that it can with advantage be charged in half the time of other batteries, and will stand being quickly charged at very high rates, if required. The 42 cells of the battery are always in series, and the changes of speed are effected by means of the series-paralleling of the double-wound motor.

The system of control is such that the carriage can be run forwards at from 4 to 20 miles an hour, and backwards, as desired, and on the slow speeds in traffic without moving the controller handle. The controller is fitted under the seat, together with the leading wires and main switch, and by means of a hinged cover it is readily accessible.

A most important feature is that the electric motor acts as a perfect automatic brake when the controller is turned to "Stop"—and when going down hill the motor acts as a generator, and the car cannot exceed the speed fixed by the controller, whilst at the same time the motor, acting as a generator, returns some proportion of the electric current to the battery. This on a long journey, over a hilly country, is very useful. On a journey to Brighton—53 miles—on one charge, the current returned to the battery in this way enabled the carriage to be run an additional 2 to 3 miles at the end of the journey. There are also two mechanical brakes, a foot brake, which at the same time cuts off the current on slow speeds, and a hand lever brake.

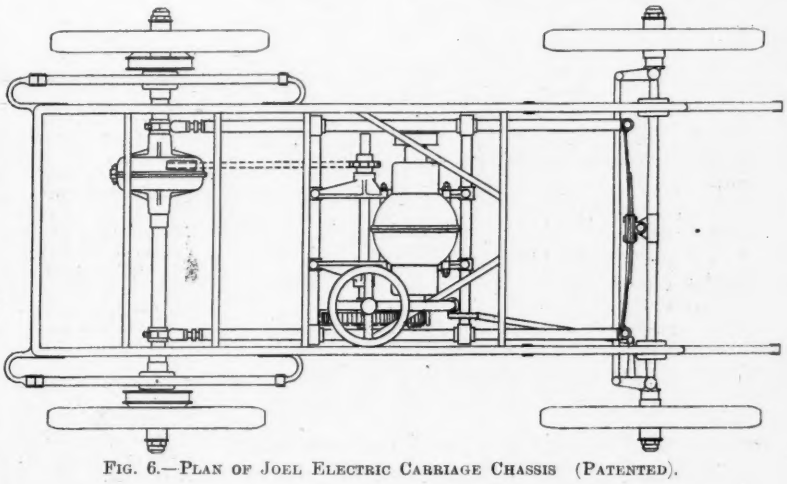


Fig. 6.—Plan of Joel Electric Carriage Chassis (Patented).

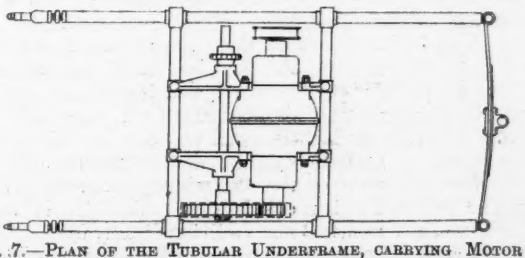


Fig. 7.—Plan of the Tubular Underframe, carrying Motor and Gears, detached for Inspection, &c.

The Scheele Electric Carriage Co., of Grosvenor Mews, New Bond Street, W., had an electric coupé on show with the chassis detached from the carriage body. It is driven by means of two 4-H.P. electric motors, one to each of the back wheels. The motors are centred and suspended from the back axle on the one side and by buffer springs on the other side, as is usual. The battery had 48 cells, arranged in two nesting trays, 16 cells over the front wheels and 32 cells over the rear wheels. The control handle is attached to an outer tube working round the steering pillar, and actuating the controller through bevel wheel gearing, in a somewhat similar manner to that fitted by the Electromobile Co.—a most convenient arrangement.

The exhibition—or, rather, lack of exhibits—of electric carriages at Olympia is a matter for most serious consideration, and the writer is earnestly wishful to assist and do all he can to obtain some more promising and satisfactory conditions to encourage the trade in the future.

He ventures to appeal to the electric supply station authorities and engineers, and invites them to find some means of agreement, so that all electric supply stations, or as many as possible, may within, say, the next 12 months, provide charging plant and garage accommodation for electric cars at a cost for energy of 1d. per unit, or such less or greater sums as may pay them, and a charge for connections, housing, cleaning or repairing such cars. Such a movement, if made general and well advertised, must, on becoming known, materially and favourably influence intending purchasers of electric cars, who would readily avail themselves of its advantages, and it would also be a source of revenue to the supply stations. Beyond this, it may be quite worth the attention of such authorities and engineers to provide customers—their own—with electric carriages on hire.

He also suggests that the electric motor-car manufacturers, users or sellers, electrical engineers, motor makers, battery makers, consulting engineers and others who may be interested, should at once form themselves into a corporate body, society, or combination for mutual assistance, and to further the interests of the electromobile industry — "The Electromobile Society." Such a society with a representative council should be of real strength, and could formulate recommendations as to some of the crucial points to be settled, viz. :—

Standard voltage of charge.

Fixing the minimum space required, or dimensions to be allowed for batteries in carriages. This would be most useful to carriage builders, and would be the nearest approach to standardising practicable.

Then there would be the questions of electric vehicle trials, exhibitions, insurance, recommendations as to type of charging board, and many others of great interest to discuss, such as ratio of weight of battery to output, system of control, &c.

He is aware of the existence of a sub-committee which has been engaged in an attempt to standardise electric motor-cars, but, of course, recommendations on such a subject should come first from those who are directly interested and specially qualified by experience to speak. There are petrol car men on that Committee who have little if any sympathy with, or direct knowledge of, electric automobiles, and others of the Committee, even if they were desirous of assisting, have not the time. The labours of such a Committee will probably be of no avail, as it is doubtful whether the Engineering Standards Committee will undertake to standardise such an immature and very complex thing as an electromobile. He frankly admits that he has no expectations from the work of the Committee, and therefore it appears to him that it is only by some such society or combination of the men who make a living directly or indirectly from the manufacture and sale of electric carriages, such as he has suggested, leading to strong and united action, that the present state of stagnation can be remedied and the electromobile industry advanced.

SMOKE NUISANCE IN ITS LEGAL ASPECT.

[BY OUR LEGAL CONTRIBUTOR.]

The establishment of generating stations on a large scale for the distribution of electrical power has occasioned a recrudescence of the question as to whether and how far statutory undertakers are liable for smoke nuisance. It might be thought that because Parliament has authorised the construction of large works in which a large quantity of coal is consumed, that there is an implied licence to the undertakers to create a nuisance. This, however, in the case of electric lighting companies and railway companies who have abandoned their steam locomotives in favour of electric traction affords no protection. It is first necessary to consider the relevant sections of the Acts of Parliament.

Sec. 91 of the Public Health Act, 1875, provides that for the purposes of the Act any fireplace or furnace which does not, as far as practicable, consume the smoke arising from the combustible used therein, and which is used for working engines by steam, or in any mill, factory, dye house, brewery, bakehouse or gas works, or in any manufacturing or trade process whatsoever, and any chimney (not being a chimney of a private dwelling house) sending forth black smoke in such quantity as to be a nuisance, shall be deemed to be nuisances liable to be dealt with summarily. Provided that where a person is summoned before any Court in respect of a nuisance arising from a fireplace or furnace which does not consume the smoke arising from the combustible used in such fireplace or furnace, the Court shall hold that no nuisance is created within the meaning of this Act, and dismiss the complaint, if it is satisfied that such fireplace or furnace is constructed in such manner as to consume as far as practicable, having regard to the nature of the manufacture or trade, all smoke arising therefrom, and that such fireplace or furnace has been carefully attended to by the person having charge thereof.

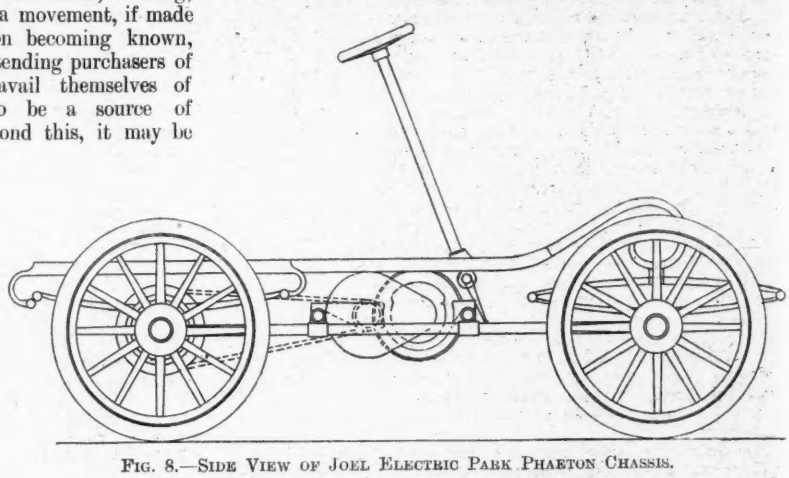


FIG. 8.—SIDE VIEW OF JOEL ELECTRIC PARK PHAETON CHASSIS.

The above provisions are practically identical with Sec. 24 of the Public Health London Act, 1891.

It should be noticed that the above section is divided into two parts—(1) that part which makes it an offence to have a furnace which does not, as far as practicable, consume its own smoke; (2) that part which makes it unlawful to have a chimney sending forth smoke in such quantity as to prove a nuisance. The proviso to the section exempts anyone from liability if the fireplace or furnace is constructed in such a manner as to consume its own smoke as far as practicable. In the case of Weekes *v.* King (1885), 58 L.T. 51), an information was laid against the proprietor of a brewery "for that black smoke was sent forth from the chimney of his brewery in such quantities as to be a nuisance." He was fined and convicted. The Court (consisting of Justices Day and Pollock) upheld the conviction, upon the ground that the proviso extended only to the first part of the sub-section, and not to the latter part, making it an offence to send forth black smoke in such a quantity as to be a nuisance. It followed from this that the defendant was not entitled to call evidence as to the construction of the furnace.

It is to be observed that, upon the authority of a very recent case, it is not necessary that a manufacturing process shall be carried on upon the premises in order to make the occupier liable. For instance, in the case of M'Nair *v.* Baker (21 T.L.R. 95), a club in the West End occupied a house with the usual club accommodation, where meals were cooked for the use of the members, and where there was a furnace and boiler for heating the premises. In addition to the servants' bedrooms there were five bedrooms for the use of members. The smoke from the cooking ranges and the heating furnace passed from one chimney. This chimney having sent forth black smoke in such quantities as to be a nuisance, it was decided that the house was not a private dwelling house within the meaning of Sec. 24 (*b*) of the Public Health (London) Act, 1891, and that an offence against the section had been committed.

In so far as the provisions of the section above set out apply outside the metropolis, they must be read subject to a very important exception.

Thus Sec. 334 of the Public Health Act, 1875, provides that, "Nothing in this Act shall be construed to extend to mines of different descriptions so as to interfere with or to obstruct the efficient working of the same; nor to the smelting of ores and materials, nor to the puddling and rolling of iron and other metals, nor to the conversion of pig-iron into wrought-iron, so as to obstruct or interfere with any of such processes respectively."

It has been held that the provisions of 18 and 19 Vict. c. 121, Sec. 44, which correspond to the above provisions, prevented the application of that Act to manufacturers of the produce of ores and minerals, so that justices had no power to order the abatement of a smoke nuisance arising from a bichromate manufactory (Norris *v.* Barnes, L.R. 7 Q.B., 537).

Again, it has been held that the owner of a coal mine cannot be prosecuted for the emission of smoke from his chimney, if he could show that the smoke could not be prevented without interference with the efficient working of the mine (Patterson *v.* Chamber Colliery Co., 56 J.P., 200).

It is to be noticed, however, that the section does not relieve the owners of mines, &c., from liability for a public nuisance in a suit brought by the Attorney-General for its abatement, nor from their common law liability to a person whose property is affected by it (A.G. *v.* Logan (1891) 2 Q.B. 100).

We have observed that there is a distinction between the law relating to smoke nuisance as applied in London and that which is applicable elsewhere. This distinction is emphasised by the following provision which appears in the Act of 1891.

Section 23 of the Public Health (London) Act, 1891, provides that—(1) Every furnace employed in the working of engines by steam, and every furnace employed in any public baths or washhouse, or in any mill, factory, printing house, dye house, iron foundry, glasshouse, distillery, brewhouse, sugar refinery, bakehouse, gasworks, waterworks, or other buildings, used for the purpose of trade or manufacture (although a steam engine be not used or employed therein), shall be constructed so as to consume or burn the smoke arising from such furnace. (2) If any person being the owner or occupier of the premises, or being a foreman or other person employed by such owner or occupier (*a*) uses any such furnace which is not constructed so as to consume or burn the smoke arising therefrom; or (*b*) so negligently uses any such furnace as that the smoke arising therefrom is not effectually consumed or burnt; or (*c*) carries on any trade or business which occasions any noxious or offensive effluvia, or otherwise annoys the neighbourhood or inhabitants, without using the best practicable means for preventing or counteracting such effluvia or other annoyance, such person shall be liable to a fine not exceeding £5, and on a second conviction to a fine of £10, and on each subsequent conviction to a fine double the amount of the fine imposed on the last preceding conviction.

In a prosecution under this section the Court may, however, remit the fine if of opinion that the accused has so constructed his furnace as to consume or burn, as far as possible, all the smoke arising therefrom, and has carefully attended to the same, and consumed or burned, as far as possible, the smoke arising from such furnace.

The question may arise upon this enactment as to whether the employer can be held responsible for the default of the servant.

In Chisholm *v.* Doulton (1889, 22 Q.B.D., 736), the owner of premises in the metropolis was summoned under the Smoke Nuisance (Metropolis) Act of 1853, the language of which is similar to that of Sec. 23. It appeared that smoke issued for the space of 10 minutes on the morning of the day in question from one of the defendant's furnaces, but it was found that the furnaces were properly constructed, and that there was no negligence on the part of defendant or his foreman. The smoke was caused by the act of the stoker who lighted the fire. In deciding that the defendant could not be held criminally responsible for the negligence of his servant, Field, J., said: "It is a general rule of law that a person cannot be convicted and punished in a proceeding of a criminal nature unless it can be shown that he had a guilty mind. . . . . It is said that the respondent is liable because he, in fact, used this furnace for the purposes of his trade. I agree that he used it, for I entertain no doubt that if this were a civil proceeding for damages he would be liable, and yet he could in such proceeding only be liable if he were the person using it. . . . . The essence of the offence is, that it should be negligent, and here the respondent took all the care he could."

The question of the liability of the owner of a mill for the negligence of his servants in causing or allowing the furnace to smoke is one which has given rise to considerable discussion. The reported cases may appear at first sight to be conflicting. As a general rule, it may be said that a master is not responsible for the criminal acts of his servant, unless he command or personally co-operate in them. Statutory offences, however, are of a quasi-criminal nature, and are treated differently. We have seen that, according to the case of Chisholm *v.* Doulton (*ubi supra*), if the offence has been committed owing entirely to the negligence of a servant, the master cannot be held liable under that particular clause of the Act. One of the elements of the offence there created was "negligence," and this word cannot be found in, much less inferred from, the construction of Sec. 24.

Another important case was Niven *v.* Greaves (1890, 54 J.P., 548). There the defendant was the owner of a mill which upon several occasions sent forth black smoke from its chimney. The furnaces communicating with the chimney were constructed in such manner as to consume their own smoke as far as practicable. The respondents had exercised reasonable and proper supervision over the persons in charge of the furnaces, and the nuisances complained of arose through the neglect of the stokers, and not through that of the respondents or their foreman. Upon the case reaching the Divisional Court, it was held by Lords Justices Coleridge and Fry that the Justices ought to have convicted in spite of the case of Chisholm *v.* Doulton. A distinction appears to have been made from that case on the ground that (*a*) to use a properly-constructed furnace negligently, and (*b*) to allow black smoke to issue from a chimney are two distinct offences, and that whereas the master must be held liable in case (*a*) he cannot be so regarded where the mischief is caused solely by the neglect of his servants.

In R. *v.* Waterhouse and Another (L.R. 7 Q.B., 545), it was decided under the Nuisances Removal Act, 18 & 19 Vict., c. 121, Sec. 12, that each daily emission of smoke was a separate act of disobedience for which a separate summons might be lawfully issued, and that the Justices were entitled to inflict fines accordingly.

Upon the authority of Gaskell *v.* Bailey (30 L.T.N.S. 560), it is not necessary to show for the purposes of procuring a conviction that the issuing of black smoke is injurious to health as well as a nuisance. That case is also of interest, inasmuch as during the hearing certain by-laws were discussed containing clauses with regard to what constitutes black smoke and medium smoke. By black smoke is meant such a volume of smoke that an object on the opposite side of the smoke to the spectator could not be perceived. By medium smoke is meant such a volume of smoke that an object on the opposite side could be perceived. It was proved that on five different days during one hour each day black smoke issued from 35 to 54 minutes during the hour, and medium smoke for nearly the whole of the remaining minutes. It was also proved that there was a foreman on the premises, and that the furnace was constructed in a proper manner, but the conviction was upheld.

In addition to the statutes above referred to, it will be seen that there are numerous questions of fact, after the investigation of which it becomes the duty of the magistrates to adjudicate upon the merits of each particular case. In determining whether a mill-owner has broken the law, the magistrates are naturally guided by the general nature of the industries which are carried on in the district, if not by the temperament and hardihood of the inhabitants who may, so to speak, have become acclimatised to the inhalation of an atmosphere ladened with a certain quantity of smoky particles and carbonic acid gas. For instance, that which in an agricultural town might constitute an intolerable nuisance would probably be regarded in Leeds, or in any other busy manufacturing centre, as a matter of every-day occurrence. In each case, it must be a question of degree.

In the case of the South London Electric Supply Corporation *v.* Perrin (which was reported in the *Times* in May, 1901), the complainant alleged that upon ten distinct occasions (specifying them), the appellants had allowed smoke to issue forth in such quantities as to be a nuisance. No witness stated that the black smoke was a nuisance to himself. The Lord Chief Justice, in giving judgement affirming the convictions, said that he must not be thought to say that the magistrate was bound to convict because black smoke issued from the chimney; but, on other hand, he did not think it was necessary to show that any particular individual or property had been injured. It was impossible for the Court to say that the magistrate was wrong in coming to the conclusion that an offence had been committed.

(To be concluded.)

PEAT FUEL.

In *Electrochemical and Metallurgical Industry* Mr. Stillings writes on peat fuel, and draws attention to the very large areas of peat land available in the United States and elsewhere. There is an area of over 11,000 square miles in Germany. Ireland's area is one-tenth peat, and some of the Irish bogs are 50 ft. deep. A square kilometre of bog 5 metres deep will yield 700,000 tons of dried peat, including, we may suppose, what must be burned in the preparation. In any case, there is a vast store of fuel in peat if it can be obtained dry.

The empirical formula for peat is given as $6\ C_6\ H_{10}\ O_5$ before decomposition. As this vegetable matter carbonises it produces $7\ CO_2 + 3\ C\ H_4 + 14\ H_2\ O + C_{20}\ H_{20}\ O_2$, the latter being the peat. Doubtless, if put under pressure as by deep burial in the earth, coal would be formed, peat being in the first stage only, whilst anthracite is the last. Approximately, of the combustible matter in peat, ten-elevenths is carbon and one-eleventh hydrogen, but part of the latter is neutralised by the oxygen. There is no sulphur, so that peat should be capable of producing an ideal metallurgical fuel.

Descriptions are given of some of the methods employed in producing peat briquettes. These generally include a tearing and kneading process, which breaks up the fibres and delivers the kneaded peat in rough bricks, which are first air-dried and then artificially dried. What is really needed, in the opinion of some engineers, is a continuous process of centrifugal drying; not a slow speed electro-complicated toy whizzer, such as some of our readers have seen, but a powerful high-speed process. Unless water can be thus ejected, the air-drying process must be very insufficient in climates like that of Ireland. Artificial drying by heat may, perhaps, then be carried on, but in a long rotary dryer, after which, still hot, and with a necessary residuum of moisture, the peat might be briquetted and further dried, though, when completely dry, even small briquettes are apt to split unless holed.

No peat process appears to us to possess the elements of success which does not include a thoroughly sound mechanical method of

garnering the peat. A friend of ours proposed to the Irish Government to gather peat by floating dredgers in the bog water and taking out the peat to the bottom by a ladder dredge. The best bogs in Ireland are all water bogs, though their surfaces may rise 10 to 15 ft. above water level. Hand-got peat is never taken out more than a spit below water level. A dredger, pumping the peat to the works, would do part of the necessary disintegration work, nor would the peat be any wetter as a result of the water carriage.

Within reasonable limits of distance, and with bare conductors at high tension, there may be something in the idea proposed by Mr. Stillings of converting the peat into gas and employing it in gas engines. But very long-distance work would not be so good as the establishment of local factories. Ireland possesses already an established woollen industry. Irish tweeds are equal to the best, and the taint of shoddy and St. Mungo has not yet ruined the character of Irish goods, so that this industry ought to be capable of extension.

In the Ziegler process, peat is carbonised in closed ovens by the heat of the gas driven off, and the waste heat furnishes the means of drying off the raw material. From a ton of peat (? how much dried) there is obtained 350 kilos. of coke, 40 of tar, 6 of alcohol, 4 of ammonia sulphate, 6 of acetate of lime, the lime and the sulphuric, of course, being added components. The idea of producing products more valuable than peat and of small weight per value unit appears sound. Ordinarily it is claimed that peat fuel may be produced for 8s. per ton. The Ziegler process costs more, but produces more costly by-products.

One man with a digger (machine?) will dig 5 tons of raw peat in an eight-hour day. This is only equal to half a ton of dry fuel apparently. A dredger 110 ft. long would gather 180 cubic metres per hour, or, say, 18 cubic metres of dry peat, or 150 tons in a day with, perhaps, three men as a crew, thus reducing labour charges to a very low point. The dredger quoted would gather the above measure of heavy clay. On peat it could be run at least twice as fast.

PROCEEDINGS OF INSTITUTIONS.

INSTITUTION OF ELECTRICAL ENGINEERS.

Birmingham Local Section.

The opening meeting of this Section was held at Birmingham on November 23rd.

Dr. Sumpner having taken the chair, congratulated the members on the success of the previous session's work, and pointed out that not only had all the papers been published in full in the Institution *Journal*, but also two of them had been awarded Premiums. The most important event of the session was, however, the coming of Prof. Kapp, who was present with them for the first time, and whom they would cordially welcome. Among his many great services rendered to the electrical engineering industry, perhaps none was greater than that rendered when, in 1885, he pointed out, simultaneously with Dr. Hopkinson, the true theory of the magnetic circuit, and made it clear to dynamo designers.

After a vote of thanks to Dr. Sumpner for his services as chairman, Prof. Threlfall, the new chairman, delivered his address.

Choosing for his subject "Some Problems of Electro and Electro-thermal Chemistry," Prof. Threlfall first referred to the secrecy which is maintained by chemical manufacturers with regard to their processes, and which rendered his position somewhat delicate. The chairman then dealt with the fixation of nitrogen by electrical means, progress in which is at present retarded by the existence of the extensive nitrate deposits of Chile. Messrs. Eyde & Birkeland claim to be able to make 650 kg. of oxidised nitrogen with the expenditure of one kilowatt-year, so that 1 lb. of nitric acid would cost 0·45d. for energy, at £10 per kilowatt-year. Chile saltpetre costs 10s. 6d. per cwt. at Liverpool, equivalent to 1·7d. per lb. of nitric acid content, and therefore, under the foregoing conditions, artificial nitric acid should have a market if made in an agricultural country. The treatment of calcium carbide at 2,000° C. with nitrogen yields calcium cyanamide, which can be used direct as an artificial manure.

Turning to the manufacture of diamonds, Prof. Threlfall described the investigations of Dr. A. Ludwig, heating carbon to very high temperatures under great pressure. At a hydrogen pressure of 1,500 atmospheres, it was found impossible to form an arc between carbon electrodes, but when the two carbon rods were in contact the current would flow for a few seconds and then stop; recommence after a few seconds and again stop, and so on. This curious phenomenon was believed to be due to the conversion of the heated carbon tip into a non-conducting variety, which interrupted the current, but being transformed into graphite as the temperature fell, again became conducting. Various attempts to cool the transformed carbon very suddenly, resulted in failure to produce diamond, though sudden cooling by a jet of water at a pressure of 2,000 or 3,000 atmospheres gave a non-conducting transparent form of carbon. The author also described researches of his own in this direction, based on analogy between the properties of carbon and those of sulphur; he suggested that to make large diamond crystals it would be necessary to go to still higher pressures, of the order of 10,000 atmospheres, when the rate of cooling would probably be immaterial.

The problem of making a useful abrasive of cubic carbon was simpler; at high enough pressures carbon vapour might possibly condense in this form. The behaviour of boron, silicon and selenium under similar conditions of high pressure and temperature was also worthy of study.

The use of carbon as a soluble electrode in a voltaic cell was next dealt with, the author suggesting that possibly a gaseous electrolyte, such as ionised oxygen, would serve.

Turning to electro-chemical theory, Prof. Threlfall deplored the prolixity of laboratory electro-chemists, whose work would be better known if their papers were shorter. The dissociation theory, which applied so well to dilute solutions, and had appeared so full of promise, had proved quite unable to cope with the phenomena under more general conditions, in spite of the often misapplied ingenuity with which explanations of electro-chemical phenomena were elaborated. The complexity of these phenomena was such that theorising was of little use until the chemical reactions occurring at the electrodes should have been elucidated in detail.

The conduction of electricity through gases was a subject of great importance, and its study might eventually furnish some insight into the mechanics of conduction.

Prof. Threlfall then discussed the new lamp materials recently brought forward, and eulogised the researches of Dr. von Bolton and his colleagues in connection with the properties of tantalum and other rare metals. Graphitised carbon and osmium filaments were also discussed.

The process invented by Elihu Thomson for the manufacture of tubes of fused silica was described; in this process a carbon tube or rod, provided with water-cooled connections, is buried in dry sand of suitable quality, and heated with an electric current, when the sand grains fuse together and shrink away from the conductor. The tubes thus formed are rough and opaque, but can be dressed on a carborundum wheel, and then have the appearance of white vitreous earthenware; they can be heated red hot and dropped into water without cracking. Other methods were also mentioned.

The Chairman then turned to the private business of the Institution, and suggested that the Birmingham section should rather be entitled the "Midland" Local Section; he congratulated the members on the excellence of the papers of 1904-5, the whole of which had been published in the *Journal*. He referred at some length to the importance of military training, and suggested the establishment of a standing school of instruction, where young men could attend at convenient opportunities, instead of a volunteer camp held at some arbitrary date. Such work could be carried on by the Universities and the engineering societies, and might be the means of providing a nucleus of educated men capable of taking their place in the national defence, and already partly trained in soldiering.

Newcastle Local Section.

Abstract of Address read November 20th, 1905, by
W. M. Thornton, D.Sc., M.Eng., *Chairman.*

In every branch of engineering there are three distinct classes—proprietors, executive staff, and workmen—each of which requires suitable training. The difference between that of the first two and the last is that a knowledge of the physical laws of Nature is essential for the former, and is to be gained best by a special preparatory education. For the latter a knowledge of a few properties of matter is sufficient, to be gained during the practice of the trade. With the training of the artisan I do not propose to deal. His work may be regarded as purely an art, and is handed on through the ages by personal transmission from man to man.

It may be well to consider shortly the course of training which experience has shown to produce good results. One can assume that a boy desiring to become an engineer of the better sort has been to a good secondary school, and that he leaves at the age of 17. He should then have an adequate knowledge of his own language and at least another (French or German by preference), the elements of Euclidian and co-ordinate geometry, algebra to the binomial theorem, trigonometry to solution of triangles, mechanics of a sound, descriptive kind, and a little chemistry and physics. Classical scholarship can in the future only be afforded or attained by schoolmasters or men of leisure. There is certainly no greater handicap to a boy entering an engineering career than an education on the classical side of any public or secondary school. The pupil should, while his school work is fresh, be required to take the entrance examination at some university where engineering is taught, and this should be regarded as the finishing point of his school life.

One enters now upon debatable ground. Is it better to go straight from school into the works, or to college? There are manufacturers who prefer to have a boy straight from school, and it may in many cases be more to their interest, but no desire for cheap labour, or material to mould in any particular direction, should take precedence of the highest national efficiency. On the whole, the gain in works knowledge and stimulus, is more than counterbalanced by the loss of clear thinking and recognition of first principles which prove so valuable later. In addition to this, a boy serving an apprenticeship first rarely has a chance of showing ability within three or four years.

All colleges which provide a three or four years' course in engineering insist on a sound knowledge of the elements of mathematics, physics and chemistry. The first year is, therefore, almost entirely occupied with learning or revising these, a few descriptive classes or a little geometrical drawing being added for stimulus. If possible, mathematics should be continued through all three years. The power of facile thinking with abstract quantities, though it may rarely have direct expression in after life, is of immense service to engineers. The more advanced laws of heat and elasticity, and the simpler quantitative and higher descriptive treatment of technical subjects, will form the second year's course. That of the third year is entirely technical, and of

such an order that a student should have little difficulty on its completion in judging for himself the significance of any new suggestion or advance in practice or theory. A fourth year may well be occupied in experimental work on new ideas.

If it is to come at all, a time of speculative activity almost inevitably follows the completion of a university course, and, it may be, the taking of a degree. It is then that encouragement, and, perhaps, pecuniary help are of vital importance to a young student. He should have the opportunity of seeing how to carry out ideas by watching or helping in the research work of his professor, and the advantage is mutual.

There is in connection with experimental research a disregard by many, though not all, manufacturers of much promising material. We take our young engineers from college, and put them for years to routine work which untrained men do as well or better, and are disappointed that they do not show striking results, forgetting that two things are necessary to progress—the man and the opportunity. I would suggest that men with a first-class college record should, instead of being treated as beginners, be taken into the confidential departments, design or test room, and set to work on new things, at first under supervision.

The interdependence of science and industry has been a fruitful theme for a hundred years. One never knows to where an experiment a little off the beaten track will lead. I have recently had a good example of this, on a small scale, which may be of interest. Some years ago I made a few experiments upon bacteria, working mostly with typhoid germs on account of their sensitiveness. During these I found that M. Lortet had discovered what I was looking for, that alternating currents cause them to orientate and place themselves along the lines of flow, but he failed to find any effect with direct currents. As a matter of fact, bacteria of all kinds, living or dead, orientate in the same way under either direct or alternating electrification. It was found that the movement depended entirely upon the relative conductivity of the organism and the surrounding liquid, so that the former behaves as a rod of iron in a magnetic field, or one of a dielectric in an electrostatic field, the same laws governing lines of stress or steady flow, whether of electricity, magnetism, heat or liquids. In searching for the cause I found that glass orientates in oil, but not in water, and that carbonised silk filaments are very sensitive in either. Some time after I wished to design an apparatus to indicate the state of charge on cables, in order to see whether they were safe to handle. The simple electroscope was first thought of, but rejected as not mechanically strong enough to be placed in a platelayer's hands. It occurred that one might use the same thing on a small scale, observing the movement in a kind of linen-tester's microscope. On trying this I noticed a small spark pass between two particles of carbon suspended in oil, and the idea at once came, why not look for the sparks? In 10 minutes or so after this the first "voltascope" was made and tried on a 2,000-volt circuit, and a little while later on 20,000 volts. The instrument as it is now made consists of a glass tube containing oil and short fine carbon rods. Contact is made across the mains through a heavily-insulated wire having an ebonite or fibre handle, with sharp steel points to get good contact. It works equally well with direct and alternating currents, and in any position. As soon as contact is made the carbon filaments become polarised and form an irregular chain, along which a small current passes, jumping across minute gaps between the particles, and so forming sparks which are instantly extinguished by the oil, their constant appearance and extinction giving the tube the effect of scintillation. The working range of the instrument is from 10 volts upwards.

The same line of thought led further to the invention of the high-tension voltmeter shown. So far as I know, this differs from other forms in the use of a *dielectric* needle or quadrant. A short ellipsoid of paraffin or sealing wax is suspended by a fine silk or quartz thread between brass plates, contained in a glass globe about 15 cm. in diameter. Theory indicates that the torque on the suspension is proportional to the square of the voltage, and this is found to be experimentally true. One uses the instrument in the same way as a Siemens dynamometer or the Ayrton-Mather voltmeter of the same type. The ellipsoid is brought to a balanced position between stops by rotating the torsion head. The lowest voltage to which it is sensitive is about 500, and I have used it to measure spark-gap voltage up to 100,000. Since specific inductive capacity varies with frequency, a correction must be applied for this.

One can determine by this instrument the dielectric constants of all solids, liquids, or gases when a litre of the latter can be obtained.

These examples, given for what they are worth, serve to show that a little research with a microscope may lead to results quite unthought of at the time, in an entirely different subject and on a different scale. The microscope might be much more used in electrical engineering than it is at present, if, indeed, it is used at all. We know now that the permeability of iron is influenced by the size and distribution of the crystals of carbide of iron in the metal, and that these are changed by the heat treatment this has received. Why should we not estimate permeability by polishing a surface on the metal, observing it through a microscope, and, if necessary, photographing it? After a time, by collecting a set of standards, the quality of any specimen might be assigned in a few minutes by inspection. We have timber merchants selecting wood by inspection of the grain; why not makers of machines selecting magnetic iron in the same way, and requiring ironmakers, when quoting, to send a micro-photograph of the material?

Workshop research in the heavier branches of electrical engineering can show many examples of important results reached by following side tracks, and there are still problems of the greatest interest awaiting solution.

DESTRUCTORS AND THEIR BY-PRODUCTS.

By F. L. Watson.

(*Abstract of Paper read at Leeds, November 23rd, 1905.*)

Having explained the necessity of destroying town refuse by cremation, the author discusses the combination of destructors with electricity works—due to the facts that as a rule an electricity undertaking is the only municipal enterprise capable of fully utilising the steam from a destructor, and that both establishments are generally placed near the centre of population to diminish the cost of transmission and cartage.

Taking a town of 120,000 inhabitants, the author draws up an ideal balance-sheet, based upon the best results obtained in different towns, and showing a return (due mainly to the sale of bricks and steam) of 10 per cent. on the capital expended. He points out, however, that in no existing plant is the utilisation of residuals carried out to the extent assumed in his estimates.

Turning to the construction and working of the destructors themselves, Mr. Watson states that the chief differences consist in the methods of feeding, of taking away the waste gases, and of applying forced draught. The simplest mode of feeding is the "front feed" by hand, which is suitable for small plants, but has the disadvantage that the unburnt refuse and clinker lie on the same floor and may get mixed. The "back feed" system, on the other hand, has all the advantages of the former, and others in addition; the refuse is thrown into the furnace at the back, and the clinker withdrawn from the front. The "top-feed" system is very popular and successful. Unfortunately, it is impossible to handle refuse with mechanical appliances such as are used for coal. In a few instances provision has been made for tipping the refuse direct from the carts into the furnaces, and this is a very clean and wholesome arrangement; but in lieu of other provision for storage, it is necessary to leave the refuse in the carts until wanted, using other carts meanwhile. An alternative in large plants is to deposit the refuse in storage tubs with self-opening bottom doors, and to stack these up when full with a travelling crane.

The best method of taking away the products of combustion is that invented by Mr. W. Horsfall, in which all the outlet flues from the furnaces open into a common high-temperature combustion chamber, where they mix before passing to the boilers.

Both steam-jet and fan-blast draught have their advantages. The former is useful where there is much carbon in the refuse, while the latter is more suitable for refuse which is largely of a vegetable character, and for large destructors. Much can be gained by heating the blast.

For every 10,000 inhabitants there is, roughly, 10 tons of refuse per 24 hours, which is capable of producing over 50 H.P. if properly utilised. The most suitable boilers are of the water-tube type. The draught should not be too strong, for if it is, a great quantity of dust will be carried out of the furnace; a dust catcher should be provided beyond the boiler. The chimney need not be more than 90 ft. high.

The author gives particulars of the 12 hours' official test of the Batley destructor, carried out in May last, when 1·6 lb. of water were evaporated per pound of refuse (from and at); the mean temperature in the main flue was 2,000° F., and 406·6 gallons of water were evaporated per hour, the destructor having three cells.

Mr. W. M. Binny's report on the Sunbridge Road Destructor, Bradford, is also given, in full. This was a seven-day test. An abstract of it was given on p. 187 of our issue of August 4th, 1905.

Finally, the author discusses the allocation of costs and returns between the destructor and the electricity works, and the management of the joint undertaking. These questions are very important, but difficult. In the author's opinion, the ideal method of determining the value of the steam supplied by the destructor is to run a separate generating set with it at constant load, and to credit the destructor with the actual output. It has been said that "most of the electricity generated by destructors was produced by friction between the two departments."

THE APPLICATIONS OF ELECTRICITY IN THE ROYAL GUN FACTORY, WOOLWICH ARSENAL.

By Col. H. C. L. Holden, R.A., F.R.S.

(*Abstract of paper read in London, November 23rd, 1905.*)

The work of the Royal Gun Factory consists in the manufacture of guns ranging from 3 cwt. up to 60 tons or even more, and also in the manufacture of the breech mechanisms and other adjuncts and appurtenances of the guns themselves. This work necessitates a very large range of machine tools, from boring machines 50 yards in length, and lathes of 100 ft. bed, down to the smallest milling machines and lathes. There is, therefore, plenty of scope and opportunity for the employment of different descriptions of electrical drives.

Although there were previously several instances where in the factory electro-motors had been substituted for steam engines, it was only in 1900 that I converted the first of two large boring machines to a direct electric drive by means of a variable speed Schuckert four-pole motor of 25 B.H.P. The variation of speed was obtained by varying the excitation of the fields, and the ratio in this case was 1 to 3·5 or so, giving speeds of from 250 to 880 r.p.m., which is amply sufficient range, without any further gear, for the work that is put into these machines. The headstock which revolves the work carries between its bearings a large worm wheel,

which is driven by a worm shaft forming a continuation of that of the motor, but connected to it by a flexible coupling; the thrust of the worm shaft is taken by a thrust bearing of marine type, and through this the cutting lubricant passes on its way to the boring bar; this is only a precautionary measure, but, nevertheless, a necessary one, as it is very important that the machines should not stop during a boring operation. It would be impossible in a spur-gear driven machine, I believe, to fine bore a hole 12 in. to 20 in. in diameter and up to 50 ft. in length without a variation of 0·004 in. in diameter, which is what these boring machines are called upon to do, and do to perfection, daily.

The feed of the boring bar is worked from the motor by means of a shaft, which connects it with change gear at the other end of the bed, 150 ft. away. At this end there is also a 15-H.P. series motor, which can be mechanically coupled to the screw shaft moving the boring head and saddle, with the object of withdrawing or advancing one or both rapidly in either direction as required; in this case I have introduced a slip coupling, which in the event of an overload not only slips, but also draws attention to the fact by making a hideous noise; this is, I think, better in many ways than the overload release, and much more convenient, of course, than a fuse which has to be replaced. The change to motor driving, and the improved control of the speed, enabled us to turn out at once more than double the former amount of work done per week.

A later development of this method of driving is one whereby the driving shaft, just mentioned as running the whole length of the bed, is entirely done away with, and the one motor, now a variable-speed shunt motor, does all the feeding of the boring bar, as well as the rapid advancement and withdrawal of it and the saddle, the latter weighing 10 to 12 tons or more.

The gear is worked entirely from the main switchboard by which the man starts and stops and controls the speed of the headstock carrying the gun tube, and the switches are so interlocked electrically that it is impossible either to start the feed gear or to leave it running unless the main motor is running.

A magnetic clutch is employed in connection with this gear; but it has advantages over a friction clutch in that it can be used under conditions which would be impracticable, and in many instances impossible, for an ordinary friction clutch, owing to the fact that it can be as readily worked from a distance as from close at hand, whilst its action is quicker and more definite as to holding power, and it cannot possibly stick or seize.

I am at present using two types of these clutches, one rated at 6 H.P., and the other at 25 H.P. at 300 r.p.m.; 21 watts are absorbed in the magnetising coil of the 6-H.P. clutch, and about 42 in the coil of the 25-H.P. clutch. This gives an efficiency of under 1·5 watts per H.P. in the case of the 6 H.P., which actually transmits 14·36 H.P. at 300 r.p.m.; the 25-H.P. clutch is still more efficient. The diameter of the clutch has a more important effect upon the number of watts per H.P. transmitted than any other factor, and it is quite feasible to transmit 1 H.P. for ¼ of a watt or even less. These figures as regards H.P. transmitted were obtained with the surface of the clutches dry and free from oil. Some 117 of these clutches are in daily work at the gun factory, and are applied to a variety of purposes.

For driving the lathes and other machine tools in the gauge room, the motor, a 15-H.P., is attached to the wall, and drives the main shaft, which runs down the centre of the shop, by means of a belt at a point about midway in its length at a speed of 450 r.p.m. There is none of the usual countershafting and its multiplicity of belts; instead, there is one cone pulley over each machine, driving the machine in the usual manner with a belt. These cone pulleys are carried on tubular bearings through which the main shaft passes quite clear, while the bearings themselves are supported on brackets; the pull of the belt thus does not come upon the shaft when the cone pulley is not running and the machine is idle. The cone pulley carries the armature of the clutch at one end of it, and against this end the electro-magnet with its collecting rings is keyed or otherwise fixed to the shaft. Very slight longitudinal play in its bearing is given to the cone pulley, and a slight bias is given to the belt drive, so that the tendency of the pulley is to run from the magnet when the latter is de-energised. It is found that by adopting this simple method no spring or other device is required to keep the surface from contact or rubbing when the clutch is not in action. The extent to which frictional losses are reduced can be imagined when it is explained that when the motor-driving belt is thrown off, and there is no current on the clutches, the main shaft can be revolved between the fingers. The switches used to actuate the clutches are of a selective type—that is, when the current is off, a pull at the switch rope puts it on, and a second pull cuts the current off again. This appears from practical experience to be more convenient than the ordinary bell-shifting method, in which two ropes are employed, one to put the power on and another one to cut it off.

The north-east shop is the most recent shop built in the Royal Gun Factory, and it was designed with a view to electric driving; it is a lofty building measuring 200 ft. × 120 ft. Altogether on the ground floor there are 83 machine tools, of which 21 are separately motor-driven, the other 62 being grouped and driven from one of the four main shafts which serve the same number of bays. The method of driving these main shafts which are 200 ft. long is by means of a 30-H.P. motor suspended from the girders and situated in the centre of the shaft, to each half of which it is coupled direct; the speed of the shaft is 250 r.p.m.

In the grindery some 12 Gisholt tool grinders are continuously in use, and the problem to be solved was to drive them in the most economical and efficient manner. The grinders were arranged half on either side of the shop and driven by belting from a shaft running at very nearly the same speed as the wheels, and coupled direct through a flexible coupling to a 6-H.P. shunt motor standing on a bracket fixed to the wall.

The method adopted for driving a large rifling machine enables the rifling of a 12-in. gun to be carried out in 40 hours, six grooves being cut simultaneously, whereas only a few years ago the same operation, with one tool only cutting, took more than three weeks, working day and night.

For lapping the bores of guns—an operation which has to be done in order to get the extreme uniformity of diameter that is necessary in the bore, there are three machines in the factory for dealing with various sizes of guns. Two of these were designed to be driven by separate motors, and the third was converted to an electric drive.

A portable electric lapping machine has been devised for use on board a ship or elsewhere. The machine is attached to the muzzle of the gun, and rotation is imparted from the motor to the machine by a flexible shaft.

So far as planing machines generally are concerned, I am in favour of cutting in both directions with two separate tools whenever and wherever it is possible, the economy in power, time, and labour, being greater than having a quick return stroke, for it is obvious that however rapid the return stroke may be, time is lost, and no useful work is done. This will explain why the gear is so designed that the speed of the table in either direction is the same. In the case of planing machines, as in the case of the boring machines, I hold a strong brief for the screw drive as against the rack and pinion drive. The former undoubtedly does the better work. The planing machines are driven by a shunt-wound variable-speed motor, which runs continuously in one direction, and drives, by means of a bevel pinion, two bevel wheels revolving in opposite directions; these two bevel wheels are concentric with the shaft which drives the screw of the planing machine, and are each furnished with a magnetic clutch, by which they can be attached to the shaft; the clutches are alternately energised by a rocking switch, actuated by adjustable tappets on the bed of the planer. The reversing action of these machines is very quick and silent. No check or change of speed is discernible in the motor, though, of course, the ammeter shows a momentary rise of about 25 per cent. on the reverse.

Electricity has been of assistance to us in enabling the amount of eccentricity of the bore of a gun which, as sometimes happens, has from one cause or another become bent, to be readily ascertained. You will, I am sure, appreciate the difficulty in first of all ascertaining, and, secondly, actually measuring, the want of truth in the bore of a gun 20 to 30 ft. from the breech end, which distance it may easily be, as the 12-in. gun is 45 ft. in length. The means adopted, however, are, thanks to electricity, quite simple. A tapered steel tube, stayed and tied with a single gun wire so as to bring both ends of the tube to the same level, carries at one end a knife-edged contact wheel about 2 in. in diameter, this wheel being insulated from the tube, but connected to a flexible conductor passing down the interior of it to the other end of the tube which is fixed in the slide rest; a dead-beat galvanometer and a couple of dry cells complete the equipment. When the wheel touches the metal of the gun the circuit is completed through the galvanometer, which indicates accordingly. The movement of the slide rest, necessary to make contact, reveals the amount of eccentricity.

When any billet of steel arrives in the factory, the first thing to be done is to obtain a small quantity for chemical analysis. This is generally taken in the form of fine drillings from a point midway between the centre and exterior of the billet and at both ends. Until current was generally available throughout the factory this was quite a lengthy operation, involving the loss of time taken to fix a ratchet brace, and then the time to drill the hole in order to obtain the shavings; by the aid of the electric drill the time lost in fixing is eliminated entirely, and the drilling by power is quite a short operation.

The use of the electro-magnet for lifting projectiles was introduced by me many years ago when the 110-ton gun was in use. The cast-iron projectiles for proof were exceedingly awkward things to remove from the pile and sling for the crane to lift; this was made delightfully easy by substituting an electro-magnet for the sling. The magnet used consisted of one piece of mild steel of ⌐ section, and 10 in. in length, with a single coil wound round it longitudinally—the surface magnetised was 30 sq. in., and the maximum weight it had to support 1,800 lb., the weight of the projectile of the 110-ton gun, though there was ample power to spare. The weight of this magnet, complete with the shackles for attaching it to the crane hook, was under 56 lb., and the electrical energy required for the maximum lifting power was 120 watts.

Measuring temperatures is most conveniently done by electrical means, and for our purpose the measurement by means of the electromotive force generated by a thermo-couple has been found to be the best adapted.

The thermo-junction we use is a platinum and iridio-platinum one, in conjunction with a modified form of D'Arsonval galvanometer to measure the electromotive force which indicates the temperature. The instruments are fixed in various parts of the factory, and connected up to the reheating, annealing and tempering, &c., furnaces, as also to the lead baths for tempering steel specimens, in such a manner that the temperature of any one of them can be immediately ascertained by those in charge, and regulated accordingly; but this is not all. From each of these centres line wires are led to the metallurgical laboratory, where there is a standard recording instrument, and by this means not only can a continuous record be taken of any operation desired, but the individual instruments can be, and are, constantly checked to ensure accuracy and uniformity with the standard, for which purpose the points are connected by telephone.

To sum up, there are at work at the present time in the Royal Gun Factory 134 motors of an aggregate rated horse-power of 1,903, whilst there are 61, either connected or ready to be connected, to the supply mains when current is available, of an aggregate rated power of 840 H.P. more. The largest motors—viz., 100, 50 and 40 H.P., are all connected to individual machines. The number of magnetic clutches in use is 117, 31 rated at 25 H.P. and 86 at 6 H.P. Of magnetic chucks and holders there are 16 in use, but fresh fields of application are continually being found for them, and their numbers are, therefore, constantly on the increase. Magnetic holders are of the greatest service in connection with surface grinding machines, and enable small steel work to be turned out with the greatest accuracy and rapidity. One instance may be given of the utility of the magnetic lathe chuck, and that is in turning obturator rings. These rings are made from extremely hard-tempered steel, so hard, indeed, that they can only be cut at a very low speed with specially hard tools, yet it is found that, in spite of the small surface area they afford for the magnetic attraction, and also of their somewhat low permeability, the magnetic chuck is the most effective method of holding them whilst being turned that we have yet been able to devise.

It may be of interest if I add a few data as regards the amount of material removed per E.H.P. per minute on various machines—the E.H.P. is the gross amount required not only to drive the motor and machine, but also to do the work.

Type of machine.	H.P. of motor.	No. of tools.	Cut. Inches.	Feed. Inches.	Weight of material removed per hour.	Lb. per E.H.P. per minute.
					lbs.	
Fine boring machine	30	1	1·4	0·04	118·86	0·082
Rough boring machine	30	1	2·0	0·033	288·3	0·239
Experimental lathe	70	1	1·0	0·5	1,652·0	0·38
,, ,, ...	—	2 each	0·5	0·5	1,652·0	0·417
,, ,, ...	—	1	0·5	0·5	826·0	0·375
Medium boring machine, 5·75 hole from solid	15	—	—	—	132·6	0·142
Double-ended boring machine, 4-in. hole from solid	15	—	—	—	70·0	0·0956
One end only working	15	—	—	—	140·0	0·147
Heavy single-spindle milling machine	15	—	—	—	14·0	0·049
Heavy double-spindle milling machine	15	—	—	—	85·0	0·109
Radial drill, ⅝-in. high-speed twist drill	10	—	—	—	—	0·115
,, 1¼-in. high-speed twist drill	—	—	—	—	—	0·180
,, ⅝-in. ordinary twist drill	—	—	—	—	—	0·04
,, 1¼-in. ordinary twist drill	—	—	—	—	—	0·056

ELECTRIC DRIVING OF WINDING DRUMS FOR PIT-MOUTH HAULAGE.*

This paper is devoted to a practical and theoretical consideration of the conditions affecting the driving of winding drums by electric motors, with special reference to a system adopted at the beginning of 1905 by the Société des Charbonnages du Hazard, at Héron, introduced by the Cie. Internationale.

In discussing the various systems at present in use for the purpose, the author rejects as obsolete those in which a battery or a resistance in the main circuit of the motor is employed, on the score of lack of economy. He cites as modern practice those systems employing a special dynamo for the motor driving, devoted to that purpose only, whose voltage admits of adjustment; and those in which an auxiliary dynamo, acting as a reversible booster, is run on the positive lead from the supply to the motor. Further improvement in compensating for the shock caused by the sudden cessation of the load has been rendered possible by the introduction of steel fly-wheels capable of running at a peripheral speed of 100 metres (325 ft.) per second.

The author proceeds to calculations demonstrating that, in the curve showing the current taken by the motor, the reduction of the initial peak caused by the start, and the spreading of the starting acceleration over almost the entire time occupied by the upward pull, as well as the maintenance of constant current after the first few turns, are possible, in dealing with balanced loads.

He remarks that, to improve the efficiency of the machine, it is necessary to diminish, as far as possible, the importance of the losses in the fly-wheel. To do this, the time of the stops (loading and unloading) is reduced to the minimum by the use of loading and unloading stages at different levels, or by automatic counterbalancing. As the time of stopping diminishes, the output of coal per day remaining constant, the speed of the journey may be lessened, needing a motor and fly-wheel of smaller size. The cost of installation will thus be less, and the efficiency of the plant greater. The author considers the various possible combinations which have been tried and devised, with a view to keeping the demand for power constant. He discusses:—

1. Generator and fly-wheel on crankshaft of steam engine, driving winding motor. Here fluctuations will occur, owing to the drop in speed of the engine when the load comes on, the rise when it goes off.

2. Winding motor driven by a rotary transformer using continuous current, with fly-wheel between dynamo and motor of transformer. This works well with automatic regulation of the exciting current of the transformer motor (Siemens-Schuckert system) or with a reversible booster on the positive lead between the transformer and the supply (Lahmeyer).

3. Rotary transformer driven by a three-phase motor, the dynamo of the transformer driving the winding motor. This case is similar to that of the steam engine; steadiness is not attained.

4. Motor with heavy fly-wheel *c*, connected across the mains of the generator *a*, driving the winding motor *b*; *i.e.*, the fly-wheel motor is in parallel with the winding motor. With this arrangement regulation is effected not through the motor of the transformer, but at the dynamo. A further modification is effected by introducing a booster *d* on the positive lead between the dynamo *a* and the winding motor *b*, mounted on the same shaft as the fly-wheel and its motor *c*. When the winding motor is stopped (loading and unloading), the booster *d* is out of circuit; the motor *c*, connected in parallel with the motor *b*, is then tending to increase the speed of the fly-wheel. During the working period, the booster *d* gets the benefit of the fly-wheel momentum, which it transfers to the winding motor. The action of this combination is thus a transference of loads on the generator, keeping the demand constant and the fly-wheel always running; but, with the generator, four electrical machines are needed, or five, including the transformer motor, between the mains and the supply.

5. Motor *d*, with heavy fly-wheel, on the positive lead between the generator *a* and the winding motor *b*. This is the system applied at Héron.

If direct current is given by the supply, the only machine between the supply and the winding motor is the motor on the positive lead. If the supply is three-phase alternating current, it is necessary to transform to continuous. The machines between the supply and the winding motor are then—three-phase motor driving continuous current dynamo, driving winding motor through the auxiliary motor with fly-wheel.

The author proceeds to describe the installation at Héron, in which this arrangement is used:—

The supply here is three-phase alternating, 48 periods, at 2,000 volts, from a power house a mile from the works.

The following particulars are also given:—

Useful load	2,000 kg. (nearly 2 tons).
Depth of shaft	313 metres (341 yds.).
Mean speed of cage per second ...	4·3 metres (14 ft.).
Dead weight of cage and trucks ...	2,160 kilos.
Reduction in gearing	5 to 1.

Fly-wheel weighed 1,700 kilos (1·6 tons), and was 6 ft. 6 in. in diameter.

The motor driving the transformer (first machine from supply) is a synchronous three-phase machine taking about 360 amperes. The dynamo (second machine) gives 700 amperes at 157 volts during the winding period.

The auxiliary motor (third machine), with fly-wheel, has to be capable of taking the current from the generator during the loading and unloading periods. It has the same current through it as the winding motor, *i.e.*, 700 amperes, and must be capable of a voltage equal to that of the generator. The winding motor (fourth and last electrical machine between the drum and the supply) needs 225 volts at the start. The difference has, therefore, to be made up by the fly-wheel driving the auxiliary motor. The efficiency of this combination, taken on different occasions, varied from 33 to 39·1 per cent. For an output (lifting) of 200 tonnes (per day, 196 tons, about), the author calculates the annual consumption at 168,000 units, from which he reckons a cost of 4·2 centimes per ton, or ·4 of a penny. This is based on a kilowatt-hour produced from 3·3 lb. of coal.

In working, the machinery is controlled by four levers:—

1. The reversing lever, giving the required direction according as it is pushed forward or drawn backward, controls the armature and exciting circuits of the winding motor through interposing resistances, if in intermediate positions.

2. The accelerating lever, controlling the excitation of the auxiliary dynamo with fly-wheel.

3. Slowing lever, controlling the voltage of the generator. Not moved during the work, but placed in a position corresponding to the greatest speed required, and maximum power desired.

4. Brake lever.

An ampere-meter shows the current given out by the generator. A voltmeter acting in either direction shows the working of the auxiliary dynamo. A governor and circuit-breaker are arranged to break the main circuit if the speed of the fly-wheel exceeds 800 r.p.m. A safety brake comes into operation when the current is cut off, or if the cages pass above the discharging level.

* Paper read before the Liége Congress by M. L. Creplet, engineer to the Compagnie Internationale d'Electricité, of Liége.

New Zealand.—The New Zealand Customs authorities have lately given a decision that air brakes for electrical cars are to be classified as "electric machinery and appliances," the duty being 10 per cent. *ad valorem*.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

6,790A. "Improvements in apparatus for electro-plating." L. Potthoff. (Date applied for under Rule 5 of the Patents Rules, 1905, March 30th, 1905.) December 1st. (Complete.)

24,452. "Improvements in incandescent electric lamps." F. Harrison. November 27th.

24,461. "Improvements in or in connection with drain, sewer, water and other pipes, and electric conduits." H. E. Routledge. November 27th.

24,475. "Improvements in appliances for carrying and suspending globes for inverted incandescent electric and other lamps." W. Anderson and H. Anderson. November 27th. (Complete.)

24,482. "Improvement in electric incandescent lamp." J. Skwirsky. November 27th.

24,494. "Improvements in electrically-driven clockwork mechanism for registering and indicating purposes." W. R. Sykes, jun., F. T. Hollins and F. W. Leake. November 27th.

24,502. "Improvements in or relating to electric arc lamps." A. Blondel. November 27th. (Complete.)

24,507. "Process for electrolytically producing peroxide of hydrogen." G. Teichner. November 27th. (Complete.)

24,518. "Self-generating steam or hot-air power electric machine." C. P. A. Dahl. November 27th.

24,538. "Improvements in electrodes for electrolytic apparatus." F. W. Howorth. (M. Kellner, E. Kellner, E. Kellner, E. Kellner, M. Kellner, heirs of C. Kellner, Germany.) November 27th.

24,539. "Improvements in electric demand indicators." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 27th.

24,621. "Improvements in or connected with electro-magnetic generators." L. A. Gianoli. (Date applied for under Patents Act, 1901, December 2nd, 1904, being date of application in France.) November 28th. (Complete.)

24,642. "Improvements in ignition plugs." A. Daveluy. (Date applied for under Patents Act, 1901, December 5th, 1904, being date of application in France.) November 28th. (Complete.)

24,698. "Improved fitting for a sparking plug for internal combustion engines." H. G. Eastwood. November 29th.

24,718. "Improvements in or relating to wireless telegraphy." F. Lori. (Date applied for under Patents Act, 1901, November 30th, 1904, being date of application in Italy.) November 29th. (Complete.)

24,724. "Process for the electrolytic manufacture of metal tubes and other bodies." W. Clark. (F. Darmstadter, Germany.) November 29th.

24,729. "Improvements in and relating to electric controllers." C. W. Atkinson. November 29th.

24,747. "Improvements in electric automobiles." A. Dinin and M. Espagnent. (Date applied for under Patents Act, 1901, December 9th, 1904, being date of application in France.) November 29th. (Complete.)

24,777. "A mechanism for setting back the motion work and hands of electric clocks." S. D. Neill. November 30th.

24,785. "An improvement in the production of the electric arc for scientific and industrial purposes." V. Mitkevitch. November 30th. (Complete.)

24,794. "Improvements in brush-holders for electrical machines." H. W. Wilson. November 30th.

24,809. "An improved system of syntonic radio-telegraphy." A. Parravano. November 30th. (Complete.)

24,810. "Improvements in the electrical control and propulsion of vehicles or trains of vehicles." J. S. Raworth and A. B. Raworth. November 30th.

24,811. "Improved means of fixing an electric bell to an alarm clock and the like." H. R. Rushton. November 30th.

24,850. "Improvements in or relating to switches or controllers for electric motors for ships' steering gear, hoists, and the like." J. G. Cockburn. November 30th.

24,853. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 30th.

24,855. "Improvements in and relating to electric resistances." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 30th.

24,856. "Improvements in and relating to vapour electric apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 30th.

24,858. "Improvements in electric fire alarm systems and apparatus." H. Hawthorn. November 30th.

24,867. "Improved ignition device for internal combustion apparatus." P. M. Justice. (Industrial Development Co., United States.) November 30th. (Complete.)

24,877. "Improvements in dynamo-electric machines." A. F. Hills, D. Urquhart and A. E. Honey. November 30th.

24,882. "Improvements in and relating to electric arc lamps burning mineralised carbons." H. Hegner. November 30th.

24,902. "Insulating supports for conductor-rails of electric railways." H. L. Doulton and C. E. Morris. December 1st.

24,931. "Improvements in or relating to electrical time switches." R. F. S. Venner and R. C. Griesbach. December 1st.

24,943. "Improvements in telephonic and other electrical apparatus." M. R. De Malval. December 1st.

24,962. "Improvements in or relating to electric traction systems." E. A. Mitchell and The Dolter Electric Traction, Ltd. December 1st.

24,995. "Method and means for the control of any bank of electric lamps, displaying characters and the like." G. E. Carr. December 2nd.

24,996. "Improvements in and relating to electric arc lamps." L. B. Codd. December 2nd.

25,007. "Improvements in trolley poles." T. Walls. December 2nd.

25,032. "Improvements in electric stoves." O. C. Hawkes. December 2nd.

25,047. "Improvements in and relating to vapour electric apparatus or devices." Sir O. J. Lodge, Knight, A. Muirhead and E. E. Robinson. December 2nd. (Complete.)

25,058. "Improvements in and connected with the insulation of electric cables." The Land-und Seekabelwerke Akt.-Ges. (Date applied for under Patents Act, 1901, December 2nd, 1904, being date of application in Germany. December 2nd. (Complete.)

Paris Motor Show.—The *Morning Post* special correspondent in his account of the Paris motor show reports that a new electric car is shown "with a Zedecco accumulator, that can run 320 kilometres on a single charge, the replenishing being done by changing the positive plates of the battery placed beneath the bonnet, so that the car presents the appearance of an ordinary petrol touring machine. The accumulator is lighter, more efficient and sturdier than those formerly placed on the market, the usual negative lead electrode being superseded by a special zinc one.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

Transforming the Energy of Electric Currents. E. Weintraub. (Date applied for under International Convention, July 23rd, 1903.) 16,258. July 22nd.

Construction of Section Insulator for Electric Trolley Wires or the like. T. E. R. Phillips. 23,253. October 28th.

Alternating Current Electric Generators. British Thomson-Houston Co., Ltd. (General Electric Co.) 24,874. November 16th.

Electrode for Apparatus Producing Radiant Electrical Energy. Siemens and Halske Akt.-Ges. (Date applied for under International Convention, November 24th, 1903.) 25,282. November 21st.

Electric Power Transmitting Mechanism. British Thomson-Houston Co., Ltd., H. S. Meyer and B. Hopps. 25,636. November 24th.

Electric Meters. O. Imray. (Soc. pour l'Exploitation de Compteurs Electriques Rittener & Co.) 26,283. December 2nd.

Electro-Magnetic Apparatus such as is Used in Electric Belts. H. H. Lake. (C. J. Schwarze and A. M. Kells.) 26,772. December 8th.

Electrical Counting Apparatus more Especially Applicable for Use in Connection with Ships' Logs. T. Crawford. 27,082. December 12th.

Control of Electric Motors and Apparatus Therefor. British Thomson-Houston Co., Ltd. (General Electric Co.) 27,083. December 12th.

Means of Reflection in Connection with Electric and other Lights. T. D. Jackson. 27,317. December 15th.

Electricity Meters. W. Hamilton and Ferranti, Ltd. 27,399. December 15th.

Electric Demand or Rebate Indicators. F. M. Lewis and Reason Manufacturing Co., Ltd. 27,926. December 21st.

Electricity Meters. S. Matthews. 28,044. December 21st.

Treating Carbon and Methods of Producing Same. British Thomson-Houston Co., Ltd. (General Electric Co.) 28,062. December 21st.

Permeable Diaphragms for Use in Electrolytic Cells. H. Hirtz. 28,129. December 22nd.

Electrical Switches, Plugs, and the like. W. W. Strode and G. H. White. 28,252. December 23rd.

Instruments for Indicating the Charged or Uncharged Condition of Electric Cables or other Electric Appliances. W. M. Thornton. 28,278. December 23rd.

Electrical Gas-Igniting and Extinguishing Apparatus. H. L. Down and D. H. Wiseman. 29,343. December 31st.

Electrical Gas-Igniting and Extinguishing Apparatus. H. L. Down and D. H. Wiseman. 29,345. December 31st.

Electrical Gas-Igniting and Extinguishing Apparatus. H. L. Down and D. H. Wiseman. 29,346. December 31st.

Rheostats. C. Wirt. (Date applied for under International Convention, November 6th, 1903.) 23,726. November 2nd.

Telegraphic and other Transmitting Apparatus. J. T. Armstrong and A. Orling. 23,952. November 5th.

Electric Motor Control and Apparatus Therefor. British Thomson-Houston Co., Ltd. (General Electric Co.) 24,699. November 14th.

Single-Phase Commutation Electric Motors. T. von Zweigbergk. 25,386. November 22nd.

Control of Alternating Current Motors and Apparatus Therefor. British Thomson-Houston Co., Ltd. (General Electric Co.) 26,290. December 2nd.

Mechanism for Use in Conjunction with Apparatus for Utilising Electro-Magnetic or "Hertzian" Waves. M. H. Smith. 26,391. December 5th.

Instruments for the Measurement of Wave Lengths in Wireless Telegraphy. J. A. Fleming. 27,683. December 19th.

Telephones for the Use more Particularly of Divers. E. C. Lacey and J. Holman. 28,749. December 29th.

Electric Insulation. M. Meirowsky. 29,057. December 30th.

Electric Dry Batteries. H. W. Butler. 29,065. December 30th.

Metal Reflectors for Use with Electric Lanterns. J. A. Rey. 29,074. December 30th.

Fuses for Electrical Circuits. M. B. Field and Ferranti, Ltd. 29,377. December 31st.

Arc Lamps. O. Könitzer. 29,448. December 31st.

1905.

Particular Type of Rheostat. Veritys, Ltd., and A. E. Got. 17,146. August 24th.

Devices for Conveying Fresh Air, Telephonic and other Messages to the Interior of Submerged Submarines, Applicable also for other Purposes. F. A. Smith. 17,170. August 24th.

Vapour Electric Apparatus for Current Rectifying and other Purposes. A. Churchward. (Date applied for under International Convention, January 18th, 1904.) 954. January 17th.

Electric Fans. British Thomson-Houston Co., Ltd. (General Electric Co.) 3,918. February 24th.

Electric Motors. J. Burke. 4,040. February 27th.

Sparking Plugs for Electrically-Fired Internal Combustion Engines. H. Lewis, W. Hill and J. Whitfield. 4,321. March 2nd.

Electric Time Switch. H. Lübach. (Rights under Patents, &c., Act, 1901, not granted.) 4,354. March 2nd.

Central Station Telephone Systems Working with a Common Battery. I. B. Birnbaum and F. G. Bell. 4,883. March 8th.

Fallers for Electric Stop-Motion Mechanism for Looms and other Textile Machinery. J. B. Whitney. (Date applied for under Patents Rule 9, April 3rd, 1905.) 6,987B. April 3rd.

Electrical Alarm Mat. J. Skinner. 7,082. April 4th.

Multiple-Unit Control for Electric Motors. T. S. Perkins and R. P. Jackson. (Date applied for under International Convention, June 6th, 1904.) 8,196. April 17th.

Electric Conductors and Methods of Insulating the Same. British Thomson-Houston Co., Ltd. (General Electric Co.) 13,384. June 29th.

Starting Switch for Three-Phase Electric Motors Having a Resistance in Series with the Rotor. Siemens Bros. & Co., Ltd., H. Berry and C. M. Toplis. 13,587. July 1st.

Electrical Testing Devices. G. Harrison. (Electric Railway Improvement Co.) 13,954. July 6th.

Construction of Sound Proof Telephone Cabinets and other Chambers. R. Haddan. (Akt.-Ges. Industrie für Holzverwertung.) 14,131. July 8th.

Electrical Switch Apparatus for Supplying Current Consuming Devices on Several Motor Cars of Electrically Propelled Trains. Siemens Bros. and Co., Ltd. (Siemens Schuckertwerke G.m.b.H.) 14,208. July 10th.

Apparatus for Exploding Mines by means of Electrical Waves. F. Schneider. (Date applied for under International Convention, October 25th, 1904.) 17,740. September 1st.

Means of Rectifying Alternating Electric Currents. F. S. Povah and S. G. Livett. 18,013. September 6th.

Electrical Measuring Instruments. M. B. Field. 1,563. January 26th.

Contact Breakers of Induction Coils. M. A. Codd. 1,891. January 31st.